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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Inset—The Dog.

When we peruse certain of the more popular daily newspapers, we confess to a superiority complex, as we fail to be impressed or even interested by such news items as a picture carrying a caption "Famous Jockey joins Empire Free Trade Crusade"; but we are interested and impressed by a realisation that there exists a public which not merely wants such "news," but eagerly devours it. A natural corollary is, what sort of a mental make-up has the average foundry executive, and what does he expect from his own newspaper? Sometimes, after visiting a few of the "show" foundries, either at home or abroad, we are deeply conscious of the exacting nature of our work in collecting, presenting and disseminating news and data for such enterprising executives. Then, perhaps, we have a conversation with a moulding-machine supplier, who relates his latest trouble. He has just supplied a machine to a foundry, and a complaint is received that the guaranteed production is not forthcoming. A visit reveals that the management have failed to place the sand and the boxes anywhere near the machine, and a test under sane working conditions more than satisfies the management. A week or so later, a second complaint is received that the pattern-drawing mechanism is yielding bad moulds. Then another visit is made, and after *cleaning* and *oiling* the machine, the operatives fail to produce a *bad* mould, even with the deepest patterns.

The recognition of the fact that even in these days of rationalisation, such elementary duties as orderly production, regular lubrication and adequate plant maintenance are disregarded, places those who cater for its material progress in the position of an elementary school teacher, instead of occupying a professorial chair at a University.

Recently in Liége, we noticed that the British party was made up almost entirely of the representatives of the large well-organised establishments, whilst those which would obviously benefit the most by examining the conduct of foreign foundries were absent. We regret that this type of message is still necessary, and to those well-organised foundries, both large and small, to which our remarks do not apply, we would ask them to bear with us on the grounds that inefficient foundries somehow manage to undercut prices, as their costing systems are equally chaotic.

Thus it appears that at the moment we shall still have to print news in technical journals analogous to the daily newspaper's picture of the jockey, but are hoping that the time is rapidly passing.

Personality in Industry.

We had occasion to remark recently that the business man is not as a rule concerned with psychology. It would, perhaps, be truer to say that he is not as a rule aware of his concern with psychology. He has all the practical man's mistrust of "isms" and "ologies" and their exponents, forgetting, indeed, that when a high-sounding name is invented it implies as a rule no more than an attempt at scientific treatment of a subject already sufficiently well known. The dictionary tells us that psychology is the science of the nature, functions and phenomena of the human mind. The science may be a new one: its subject-matter is as old as man himself. For the subject-matter of psychology is, quite simply, human personality. And how many business men can honestly say that they have no concern with human personality, whether they control three employees in an office or three thousand in a works? Mechanisation has made great strides of late years, but we are not yet within remote sight of mechanisation so complete as to nullify the influence of human personality in industry.

The business man is, actually, intimately concerned with the subject-matter of psychology, in the sense of human personality, at every turn. On the manufacturing side, he is dependent on the personality of the worker, his skill, his loyalty, his reliability, how long he works, how hard he works, how well he works, and, indirectly, how he lives, how he eats, drinks and plays. On the sales side he is dependent on the personality of the purchaser, his optimism or pessimism, his response to novelty, his response to quality, his response to advertisement, his accessibility, his open-mindedness. More particularly he is dependent on the personality of the salesman, whether the salesman be himself or some bright young man with a glib tongue. He is dependent on the personality of his directors when he wants a change of policy, on the personality of the investing public when he wants new capital, on the personality of his secretary when he wants important letters typed in a hurry. He is dependent on the personality of auditors, works committees, research workers, factory inspectors, trade-union officials, railway companies. It is hardly too much to say that industry is so largely a matter of the actions and reactions of human personality that the man who succeeds does so to a great extent in so far as he is a sound psychologist. It is said of one man that he can manage men, of another that he picks the right man for every job, of a third that he always knows the right thing to say, of a fourth that everyone respects his opinion. What are such sayings but proof of the soundness of his dealings with human personality, the soundness of his psychology? That he would in all probability refuse the title with indignation is neither here nor there. The successful business man is every bit as good a psychologist as the armchair theorist, and with all due appreciation of the value of theory and theorists, is it too much to suggest that, in a world in which our lives are governed by material considerations, he is the more useful citizen of the two?

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Nickel in Cast Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with considerable interest the article by "Ecossais" in your issue of July 10 on "Melting Difficulties with Small Quantities of Special Iron."

"Ecossais" refers to the use of nickel additions in special castings for the purpose of reducing the tendency to sponginess in the iron, an effect of nickel which is found to be of the greatest service in the foundry. Reference to nickel, however, is incomplete without some mention of its effects in improving the machining qualities of the castings. This is a direct result of the fundamental action of nickel in eliminating excess carbide occurring as the result of chilling, as, for example, at corners and edges of the casting. Nickel thus improves the machining quality of the metal by eliminating hard spots. At the same time, however, nickel stabilises the pearlite, with the result that the thinner sections of the casting are hardened and densened.

Elsewhere in his notes "Ecossais" refers to methods of obtaining uniformity of structure in thick and thin sections of a casting. Experience has now shown that nickel is one of the best ways of achieving this end, and in this feature lies to a large measure its usefulness in the foundry, so that hard and dense structures can be obtained in thick sections of the casting, while the thin sections are yet grey and machinable.

Nickel is thus seen to confer a greater uniformity of structure and to give an iron of greater latitude. Apart from improving the qualities of individual castings, these features make nickel of great service in the foundry in enabling a reduction to be made in the number of mixtures required for a series of castings of different sizes. Thus the ordinary hard iron used for a heavy-section casting may be alloyed with nickel at the cupola spout to give an excellent iron for small high-quality castings.

If nickel is to be used to the maximum advantage in any particular casting, then this result will be obtained by using a nickel addition to replace an equivalent amount of silicon as mentioned by "Ecossais." From general experience it is found that each part of silicon must be replaced by two or three parts of nickel.

I would like to take exception, however, to the statement made by "Ecossais" that, in the absence of silicon control, the effect of nickel will not be beneficial and may even be detrimental if the silicon content is too high. One of the advantages from the use of nickel as an alloy element is that its effect in the iron is never found to be detrimental to the ordinary properties of the metal. Even in the poorest-quality open-grain metal the use of nickel will produce a slight hardening of the matrix. Its effect otherwise may not be great, though, under some circumstances, a refining of the grain will be obtained.

Accordingly, in using nickel, even though the composition of base iron may not be the most suitable, there are in the ordinary way no circumstances under which the action of nickel will produce detrimental effects, and this is a large point in favour of nickel as an alloy addition.—Yours, etc.,

ARTHUR B. EVEREST.

London,
July 12, 1930.

Holes in Castings.—These may be filled with a mixture of: flowers of sulphur, one part; sal ammoniac, two parts, and iron filings or borings, eighty parts. This should be mixed into a thick paste with water and applied to the hole.

A New Rotary Melting Furnace.

The foundry industry has of late devoted much attention to the development of the pulverised-coal-fired rotary furnace for the melting of cast iron. It is well known that, in Germany, considerable research has been carried out for a number of years on its perfection, the results obtained being published from time to time in the technical Press. At the same time, although it is not so generally known, similar research has been progressing in France, in which country important developments have occurred.

The Scesci Company, of Paris, has developed a rotary furnace, fired with pulverised fuel, which is intended for the melting of both grey iron and malleable iron, and which is giving remarkably good results. Several installations have now been in use in France for some months, and the results have proved to be excellent. A high melting point, giving complete solution of graphite and a consequent improved structure of the resultant iron, together with low oxidation losses and low melting costs, are amongst the advantages claimed for the furnace.

After having thoroughly examined the possibilities of various types of furnaces, one of the largest iron-founding concerns in the North has recently placed an order for one of the Scesci furnaces. This will be used for the manufacture of high-duty cast iron, including nickel and nickel-chrome irons.

We understand that Messrs. Pittevil & Company, of London and Brussels, have recently secured the sole licences for the manufacture and sale of the Scesci furnaces in the British Isles.

Recent American Researches on the Physical Properties in Cast Iron.*

By DR. P. BARDENHEUER.

A committee of eminent experts has been formed in the United States of America for obtaining reliable data for the standardisation of cast iron. Last year this committee issued a series of interesting articles on the physical properties of cast iron.

In these Papers suggestions were made for the classification of cast iron into 40 classes, according to the carbon and silicon contents. Special considerations were also to be given to the nature and condition of the raw materials, the melting process, the cooling speed and the shape and size of the castings. Proof is given in another publication that the mechanical properties of a low-carbon high-strength cast iron do not vary so much with increasing cross-section as do those of a common cast iron with a high carbon content. A further research deals with the relation between the properties of the test-bars and of the castings proper. Other publications dealt with the tensile strength of alloyed and non-alloyed cast irons, elasticity, fatigue resistance, resistance to wear, machinability, corrosion and heat treatment.

In the opinion of Dr. Bardenheuer, these various Papers contain valuable information concerning the physical properties of cast iron, which are still not sufficiently well known. The final solutions of the problems outlined are of equal interest to all foundrymen.

Cementing High-pressure Steam Pipes.—A reliable jointing cement, capable of withstanding heat, can be made from the following mixture: Red lead, 4; plumbago, 3½, and white lead, 3½ parts. This should be thoroughly mixed with boiled linseed oil to the consistency of putty. If the cement has not to withstand great heat, the plumbago may be omitted and the other two mixed in equal parts.

* Abstract of a Paper read before the German Foundry Technical Association.

Random Shots.

I see that one very well-known firm engaged in making light castings is losing no time in taking advantage of the situation arising from the new Canadian tariff. Canadian progress in recent years has been remarkable. Her exports in 1913 amounted, at present values, to over a hundred million sterling, but by 1929 they had risen to 273 millions sterling. Her imports for the same year were 253 millions.

* * *

We do not always realise that a country becoming self sufficing with regard to certain industrial products automatically becomes a market for other products which she does not manufacture. And in aggregate external trade Canada is now only fifth of all the countries of the world, coming after United States, United Kingdom, Germany and France. For her population this is extraordinary.

* * *

Two-thirds of Canada's imports come from the United States, and a sixth or a seventh (that is, half the remainder) from the United Kingdom. The natural Canadian desire to buy from the home country is being enormously strengthened by the operation of the new American tariff. But it is not sufficient to rely on a patriotic sympathy. The market must be studied, supply and distribution effectively organised, preferably through Canadian representatives. It seems better to work in close touch with a Canadian producer, where there is risk of competition with a home-manufactured article, than to compete with him.

* * *

The past week has been a positive crescendo of interest in sport. The interest taken in the second test match at Lord's was enormous, and many people who do not understand the game in the least seemed to be infected with the excitement. Wimbledon was tamer than usual in the sense that the unexpected did not happen in more than one or two matches, and players ran truer to form, with the possible exception of Cochet. This year also saw a definite setback to British hopes. Perhaps some day somebody will explain why a country which plays more tennis than any other in the world should allow others to run off with all the championships.

* * *

"Why did the foreman sack you?"
"Well, he stands around and supervises."
"Yes, but what's that to do with you?"
"I think he got jealous. People used to think I was the foreman."

* * *

MARKSMAN'S BULLS-EYES.

Silence is golden everywhere except on the talkies.

All things come to him who waits at a West End restaurant.

When a man is said to be loose, he is generally either fast or tight.

We are told a lot about Economic Man, but most of us know more about Uneconomic Woman.

No man is a hero to his golf-caddie.

To get rid of a skeleton in the cupboard, one should make no bones about it.

MARKSMAN.

The Economic Utilisation of Compressed Air in Steel Foundry Practice.*

By T. W. Barley.

It is somewhat difficult, in the preparation of a Paper such as this, to avoid over-stressing the engineering side. It is, in fact, impossible to avoid some reference to the engineer's viewpoint. Be this as it may, however, certainly foundrymen will be interested—not in the refinements of compressor design, although this, of course, is most important when considering the lay-out of new plant, but in learning how to work existing plant in the most economical way possible and/or in addition whether or no it would be still more economical either to alter existing arrangements or even purchase and install new plant.

As a consequence of a somewhat lengthy experience in the installation of and the maintenance of steel foundry plant, the author has become entirely convinced of the importance, that is, if efficiency be desired, of measurement, especially so of services such as water, air, gas, steam, electricity and fuel; not so much the mere measurement of these services in themselves, but also the results of their employment.

For instance, considering in particular compressed air, it is of but limited value simply to measure the steam, gas, oil or electricity, whichever may be employed to drive the compressors; it is equally necessary to measure the air compressed if a true picture is to be obtained, and, further than this, it is necessary to measure from time to time the air consumption of the tools employed in the foundry and driven by compressed air.

In the Imperial Works, the air compressors are motor driven, and every day a return is made of the electrical units consumed, together with the cubic feet of air compressed. These returns are scheduled, and for each week the average cost of power per 1,000 cub. ft. of air compressed is filed. At the end of each half-year the whole of the charge for repairs, replacements, operators' time and any other charges is added to the schedule, and thus the total operating cost per 1,000 ft. over the half-year is obtained. One decimal point of a penny difference in the cost of electrical current per 1,000 cub. ft. of air compressed causes an increase or deduction of £2 per week.

Let us consider a steel or iron foundry possessing compressed-air plant in which no attempts have been made to compile any costs either for compressing or for the tools themselves. What steps should be taken to put the whole plant upon an economical working basis? Obviously the most important unit, therefore, to be first considered is the compressor itself, for any losses here are continuous and not, as in the case of air-operated tools, intermittent. How is one to know whether the compressor is working efficiently or not? In the absence of any measuring devices, the answer is that one cannot know. Even if one knows definitely that the compressor was designed to give a certain output, and that one also knows that there is a corresponding input of power, one is still unable to be sure that one is obtaining the full measure of compressed air. It by no means follows that the input of power will necessarily keep step with the output of compressed air; it would, of course, if the compressor were a machine capable of maintaining its efficiency unimpaired over long periods of time, but such is not the case. In very many cases the application of air measurement to compressors thought to be efficient will indicate that not only are they not compressing their rated volume of air, but that they never have and never will do.

* A Paper read before the Annual Convention of the Institute of British Foundrymen.

An ideal compressor plant, then, must be provided with instruments for recording the power input and the compressed-air output, including also a record of the air pressure; the compressor itself will be fitted with thermometers to indicate the temperature of the cooling water and the air at each stage of compression. The inlet air should be as cool and clean as possible, and in most instances it will prove economical to filter the inlet air.

The oil used in the crank-case should be of high grade, and if the size of the plant warrants, be treated either continuously or at regular intervals by purification through a centrifugal oil separator. Unless this and the cleansing of the inlet air be attended to, excessive carbon will be deposited behind the piston rings, on the piston and cylinder heads, and, worse still, on the valves, and thus impair their efficiency. If it is realised that in a modern type two-stage compound high-pressure compressor there are 12 valves, the importance of keeping the carbon deposit down to a minimum will be readily appreciated.

Cooling Water.

This should be as cold as possible and of ample volume, whilst the pumps should preferably be so arranged that in the (unlikely) event of their failure the compressors will not be drained of water; this is especially important if an attendant is not always in the compressor house—which, by the way, is quite unnecessary with a motor-driven plant. Very large quantities of water are required for efficient cooling, especially whenever intercoolers are in use. Therefore, in most instances it is an economy to provide a storage tank and use the water continuously, either passing the heated water through an air cooler or alternatively running a proportion to waste and making up with cold.

It has been found advantageous to use water from wells, which gives a supply several degrees cooler than the town's service and has the further advantage of costing only one-fifth as compared with the public supply.

The compressors should be direct-driven by whatever prime mover be selected; all other forms of drive are wasteful of power and take up valuable room. The author has all types of compressors under his charge and has no hesitation in saying that the vertical two-stage double-acting two-crank reciprocating machine, such as is made by Belliss & Morcom and other first-class makers, is for the requirements of steel foundries the most economical and reliable machine. For very large outputs the rotary compressor is probably more efficient, but, generally speaking, the requirements of a steel foundry are not large enough to bring the rotary type within its special field, which is large output at continuous rating.

Before the compressed air can be utilised at the tools it has to pass through a system of pipes, and upon the proper proportioning of pipes and their enlargements—known as receivers—the successful operation of the tools greatly depends. If the pipes are too small the air will travel at a high velocity and carry along with it water in suspension, which will greatly interfere with the working of the tools and give rise to complaints.

Large-diameter pipes provide that the air may be kept at such a reduced velocity to permit the water to be deposited therein, and by taking off the branch pipes to the tools from the top of the air main and providing in addition a syphon pipe at the bottom of the branch no water trouble will be experienced at the tools. The provision of an inter-cooler for pressures from 80 lbs. and upwards is helpful; also, of course, the ideal would be preferably dry inlet air, but, although possible, the expense of conditioning the air to this point is at present uneconomical.

Compressor Output and Tools Operated.

This is a very difficult question to answer satisfactorily, and no hard-and-fast rule may be applied. It is inconceivable that the whole of the tools will be operating at any one time, or at the most, if such be the case, for any length of time. Some tools, such as large-size jar-ram moulding machines, will work only at considerable intervals, and then but slowly. On the other hand, when at work these tools consume very large volumes of air. Some of the small tools, such as sand rammers, chipping hammers, and the smaller jar-ram machines are at work with but brief intervals of rest, and although the consumption of air per min. per tool is comparatively low, it will yet be found that over the day the total will be greatly in excess of the large machines.

Table I details a list of tools and their actual consumption per tool against the total possible output per min. of the compressors installed. Actually the average output is considerably below the maximum possible.

Leakages.

It is most important to keep the whole of the air service free from leaks; a leak of compressed air is far more expensive than a corresponding leak of water or steam, and because a leaky air main, valve, flexible connection or tool causes no inconvenience, does not smell, as with gas, and cannot scald, it often remains unattended to for long periods. It is found that the firm's pressure recorders show up leaks if they have the service pumped up to full pressure at Saturday noon, and there is a further check at night, for then, as there is a known definite demand for air, the volume recorder shows whenever this is exceeded and the hunt for leaks is at once undertaken.

It is not the case, as sometimes stated, that pipe joints cannot be made airtight; it certainly requires more care and skill, however, than for steam or water. Leaks are traceable to valves, cocks, and rubber pipe connections, and, as often as not, neglect to close a valve properly. Very good results have been obtained from a valve packed with grease for the smaller pipes. It is a mistake to think that second or third rate will do for the main stop valves. On the contrary, only the best are good enough.

Pneumatic Tools.

The smaller tools—sand rammers and chipping hammers and the like—are the more important from an economy viewpoint, for although their consumption per min. is small, yet they are constantly in service; are subject to rough treatment, and the volume of air used per working day is a very large proportion of the total. The working parts of these tools move at a very high velocity, and this, together with the conditions peculiar to a foundry, induces rapid wear; the operators, however, are not very concerned with this and the consequent increase of air consumption, provided they can get through their work, and it will be found expedient, therefore, to take these tools into the repair shop at regular intervals for overhaul, test and lubrication, whilst issuing a reconditioned tool to the operator at the time of withdrawal. It will be found that the moving parts will, after some service, be a slack fit, and it is an entirely paying proposition to refit the cylinders with new pistons which may be obtained from the tool-makers, ground to oversize in 1/1,000th of an inch. Valves, too, require attention. By systematic inspection and maintenance not only will air be saved, but the output of the tools maintained up to concert pitch. It is important that the operators be not permitted to connect or disconnect their tools from the pipeline, for they are not sufficiently alive to the danger to the tool of sand and other

abrasive material which may quite well enter following carelessness in handling the pipe connection. To avoid all chance of this the author has devised a special method of wiring-on the rubber hose to the tools, which can only be attached and detached by means of a tool kept by the maintenance department.

The care of the jar-ram machines and the power hammers in the smith's shop follows along the lines adopted to deal with the maintenance of the compressors and these tools use in some instances more air than that stated by their makers, and considerable care should be exercised in this respect when purchasing. To avoid freezing troubles at the tools, the air should be freed from moisture, otherwise in the presence of moisture to excess in the compressed air the rapid expansion causing a drop in temperature will freeze up the exhaust.

Shot or Sand-Blast Equipment.

In this country and on the Continent, it is standard practice to use air at about 30 lbs. pressure, therefore, as it is decidedly uneconomical first to compress to 80 or 100 lbs.—the pressure used for tools—and reduce down to 30 lbs., it is desirable to use a separate compressor installation.

In a shot- or sand-blast equipment the air-load conditions are not at all comparable with those pertaining to the high-pressure equipment. It is possible to estimate more closely the correct size of compressors required to work a given plan, and, moreover, the load is far more regular in its incidence. It is rather surprising that in many installations the practice has been adopted of providing a separate compressor for each chamber or at the best two chambers; for actually a shot-blast equipment lends itself even more readily, from an economic viewpoint, than the high-pressure plant, to a central station for the compressors.

A central station has the following advantages:—(1) It saves space and building costs; (2) advantage may be taken of the "Rest" periods of individual chambers in a large installation to proportion the compressors for average loads instead of a peak load for each compressor, which must be done if one compressor per chamber is arranged; this improves the load factor, reduces capital expenditure and, incidently, maintains pressure to closer limits; (3) proper control by measurement may be provided at the lowest possible expenditure, and, therefore, the efficiency can be maintained at a high level; (4) a much higher grade of compressor can be installed; for the increased expenditure for a high-class machine will be justified only when properly controlled, so that its undoubted economy of power in large units may be consistently secured; (5) saving in pipe work; receivers, and where motor driven, in switchgear, and, incidently, the cost for one or more motors will be less for a given output than 8 or 10; (6) the cost of cooling water will be reduced; (7) the compressors will have closer supervision and in some instances the cost of this will be less; and (8) the compressor house may be situated at a sufficient distance from the shot-blast chambers as to provide better working conditions for the compressors and better arrangement of the shot-blast chambers than under the unit system.

It is obvious that the power input to compress air to 30 lbs. per sq. in. should be less than a corresponding volume at 100 lbs. per sq. in., but personal experience has shown that when measured it will be found that the bulk of the compressors supplied with a shot-blast equipment consume more units of electricity to compress 1,000 cub. ft. of free air to 30 lbs. per sq. in. than the high-pressure compressors made by first-class manufacturers such as Belliss & Morcom. Although the load factor is better in Edgar Allen's low-pressure compressors, not one in practice can compress air so economically as the high-pressure machines. Here, then, is a large field for economy, for the volume of low-pressure air required in a modern steel foundry is equal to if not greater than that required at high pressure, and it is only by measurement of air compressed and power used that anyone is in a position definitely to determine their economic position.

Conclusions.

In conclusion, the outstanding points to be emphasised to ensure economy in the compression and use of air in foundries are:—

(1) Whenever possible put down a central station and instal high-class compressors built to a guaranteed output of compressed air for a given input of power under test.
(2) Fit up volume and pressure recorders for the air, and power recorders for the prime movers; take daily readings and schedule them for ready and rapid comparison, and above all make use of the figures.
(3) Assure the compressor attendants that they have a worth-while job and that the management consider it as such.
(4) Keep the tools efficient by proper maintenance and testing at regular intervals.
(5) Test for leaks periodically, and when shown on instruments do not rest until they are found and rectified.
(6) Do not permit waste of air by misuse; it is too expensive to use for dusting down cranes, even if it saves the crane operators' own time.
(7) Do not buy cheap oil for the compressors—the consumption will be so much more that at the end of the year it will have cost as much and not given equal results to the high-grade.
(8) Pay close attention to the compressor valves and the moving parts of the air tools.

Table I.

Details of Compressed-Air Service at the Works of Edgar Allen & Company, Limited, Sheffield.

Maximum output of compressors = 1,200 *cub. ft. free air per min.*
Maximum air consumption of tools if all working at one time = 5,000 *cub. ft.*
Actual *average* output of compressors = 720 *cub. ft.*

Tools in Service:—

13 jar-ram moulding machines, 6 to 16 in.
6 sand riddles.
14 sand rammers for moulds.
4 sand rammers for cores.
10 chipping hammers for fettling.
16 riveting hammers, 40 to 80 lbs.
2 air drills.
3 10-cwt. forging hammers.
2 7-cwt. forging hammers.
2 5-cwt. forging hammers.
1 3-cwt. forging hammer.

Ratio of maximum air consumption of tools to average output of compressors = 7 : 1.

Rail Breakages in the United States.—Rail failures reported annually to the American Railway Engineering Association showed a gratifying decrease in numbers prior to the war, but have been little improved since that time. About one-third of the breakages may be ascribed to poor maintenance of sleepers and ballast, but the remainder are primarily due to a combination of segregated or unsound metal and the heavy stresses of high-speed traffic. Variations in the metallurgical structure of rail may originate in so many places during the manufacturing operations that the Association has voted a five-year research into the problem. It is proposed to manufacture several thousand tons of high-carbon steel, roll it into rail and install it in track under the most minute observation and constant supervision, reserving a considerable percentage of the rails for appropriate laboratory study and comparison with their worn mates as removed from the track. Railroads and rail manufacturers have been asked to underwrite the programme to the extent of $50,000 a year.—"Iron Age."

Lancashire Founders Visit Clay Cross.

A party of 50 members of the Lancashire Branch of the Institute of British Foundrymen visited the works of Messrs. Clay Cross Company, Limited, Clay Cross, on June 28, in response to an invitation of the directors. The party arrived at Chesterfield at 11 a.m., where they were met by Mr. David Rushworth on behalf of the company, and conveyed to the Clay Cross Works by motor coaches. The members were given a very hearty welcome by Captain Underwood, who said that Captain Jackson had expressed his regret that he could not be present to meet the guests.

The party was then taken round the foundry and shown several operations connected with pipe-making in various forms. A batch of 12 ft. by 4 in. pipes was cast whilst the members were present; and they next proceeded to the blast furnaces to see one tapped. Entering the Economiser Department, the machining of the pipes to gauges, their building up into sections by hydraulic pressure, and then the testing to 400 lbs. per sq. in. pressure, was followed with great interest. After leaving the Economiser Department, the party was taken to the coke ovens, where the coal-crushing and other operations in connection with modern coke making were demonstrated.

The members were then conveyed by the company's light railway to Ashover, where lunch was served. Mr. R. W. Stubbs, in tendering a vote of thanks to Captain Underwood, Mr. Rushworth and the staff, expressed his regret that Captain Jackson was not present, but his deputies had amply filled the breach, and the party had been very much impressed by what they had seen, in addition to the generous hospitality of the firm in providing an excellent lunch. He (Mr. Stubbs) reminded the directors that the Lancashire Branch had a Junior Section, and he would be pleased if the directors could see their way to invite the members to Clay Cross, as it would be a very instructive outing for them. Mr. Flowers seconded the vote of thanks, and this was supported by Mr. Gilpin.

Captain Underwood, in responding to the vote of thanks, said that it had been a very great pleasure to have them, and he hoped they had enjoyed themselves as much as the staff had in meeting them. With regard to the suggestion of a visit of the junior members, he, on behalf of the directors, had no hesitation in extending an invitation to them.

The members then inspected the limestone quarries, fluorspar and lead mines, where practical demonstrations of shot firing were given at each quarry, one of the shots being fired by Mr. Stubbs.

The members of the Branch desire to express their thanks to the staff, including the foremen at the mines and blast furnaces, for their efforts to make the visit such an unqualified success.

The Continental Steel Cartel.

The Continental Steel Cartel has had to abandon for the time being its efforts to maintain fixed prices for finished steel products. Any further efforts to control the finished steel market have been postponed until December. The Cartel is proceeding with its plans for controlling the sale of semi-finished steel. Recent discussions at Liége led to the approval by those present of rules for the establishment of selling syndicates for semi-products. The Managing Committee of the Cartel has now to give its decision. It is hoped to establish the sales office for semis by August 1; meanwhile it has been arranged for sales to be conducted temporarily through certain specified works in each country belonging to the Cartel.

Steel-Founders' Problems.

At the Middlesbrough Convention of the Institute of British Foundrymen, a special session was devoted to steel-foundry problems. Mr. A. Harley (Senior Vice-President) presided. The first Paper taken was "The Economic Utilisation of Compressed Air in Steel-Foundry Practice,"* by Mr. T. W. Barley.

Compressed Air for the Foundry.

The discussion was opened by MR. WILLIAM SHAW (President of the Middlesbrough Branch), who suggested that it was rather daring to have the whole of the sand-blast equipment, for instance, dependent on one central compressing plant in a steel foundry, because if a breakdown occurred the interference with production which would result would be more serious than would be the case if a number of independent compressing units were used.

Air Velocity.

MR. J. DESCHAMPS (Letchworth) congratulated Mr. Barley upon his very interesting Paper, and particularly upon the practical character of it. The method used by Mr. Barley for testing small tools continuously was a very simple one, and should prove very effective. He was interested to note that Mr. Barley did not experience trouble due to moisture in the compressed air, because, he said, the pipes conveying the compressed air to the various tools were of large size and the velocity of the air through the pipes was so low in consequence, that most of the moisture was precipitated. His own experience, however, was that, although there were advantages to be derived from the reduction of the velocity of the air in a pipe, one could not prevent the condensation of the vapour (which was always present in atmospheric air) when the air was suddenly expanded from a pressure of, say, 100 lbs. per sq. in. to nothing, and he had experienced considerable difficulties through water finding its way to pneumatic hammers, etc. Therefore, he asked if Mr. Barley considered it would be worth while installing a drier for the compressed air. With regard to the centrifugal oil cleaner, described by Mr. Barley, he asked if it worked continuously or intermittently.

L.P. or H.P. Compressors?

Mr. Barley's experience that the low-pressure compressors were less efficient than the high-pressure compressors, he was afraid, must be regarded as an isolated experience; he did not see why one should not secure quite as great an efficiency in low-pressure compressors as in high-pressure ones, and certainly his experience was not the same as that of Mr. Barley. In his works it was reckoned that the cost of compressing 1,000 cub. ft. of air to 30 lbs. per sq. in. pressure was less than half the cost of compressing a similar volume to 100 lbs. per sq. in. It would appear, therefore, that the efficiency of Mr. Barley's low-pressure compressor was not what it should be.

MR. BARLEY said that was not necessarily the case.

MR. JOHN LUCAS (Loughborough), who also commented upon Mr. Barley's statement that it was possible to produce compressed air at 100 lbs. per. sq. in. more cheaply than at 30 lbs. per sq. in., and that it was better to compress to 100 lbs. and reduce the pressure to 30 lbs. than to compress directly to 30 lbs., asked if it were possible in a small foundry, where perhaps there was neither room nor capacity for several compressor plants, to have, say, one air-compressor unit, compressing to 100 lbs. pressure for the few tools and moulding machines, and to reduce to 30 lbs. pressure for the sand-blast plant. If that were possible, he would like Mr. Barley's views as to what method should be adopted in reducing the pressure.

MR. C. A. OTTO (Manchester) pointed out that when a central compressing plant was used in a works the air had to be transported considerable distances, so that there might be considerable losses through leakage. Therefore, he asked whether the efficiency of an installation having a central plant was comparable with one having separate units, each unit being situated near to the point at which the air was being used.

Decentralised Plants.

The CHAIRMAN (Mr. Harley) said that at the Daimler foundry the compressed-air plant was centralised, but he had been considering the idea of de-centralising. With a central plant the air had long distances to travel, and he thought the trouble due to condensation was intensified thereby; further, he wondered whether it would be possible to effect economies by the erection of units serving certain self-contained sections of the foundry. Under such circumstances these units could be closed down at certain times during the day when not required, and he thought there might be more exact control of the consumption of air and also leakage in the localised areas. He would be very grateful if Mr. Barley could indicate how to overcome the trouble due to water condensing in the pipes. Much of the trouble was due to defective valves, and he (the speaker) would be glad to know if a definitely pressure-tight valve were available. With regard to the comparative high cost of compressing air to 30 lbs. per sq. in., he asked if that was due to the use of an inferior type of compressor or to other factors. Finally, he expressed his appreciation of the very thorough manner in which the subject had been dealt with in the Paper.

Author's Reply.

MR. BARLEY, dealing with Mr. Shaw's suggestion that it was a bold policy to have one central compressing plant for the shot-blast or sand-blast apparatus, and, so to speak, to place all one's eggs in one basket, said that one might reply, logically, that if one had a number of eggs rather than a single egg there was more liability of breaking any one of them than of breaking the single egg.

MR. SHAW said his suggestion was that what one gained on the swings one lost on the roundabouts.

MR. BARLEY said that his firm had used a number of compressors in the first place, and as the result of their experience they were convinced that it was better to have fewer. In laying out their new shot-blast plant, however, they did not intend to provide for the whole of the compressed-air requirements of the plant to be supplied by one compressor, but rather to use three compressors; the reason was that in any compressed-air installation in a foundry it was very difficult so to arrange matters that the compressors were always running to their full output when in use—and, of course, if one wanted the maximum efficiency they must be run to their full output. They had decided to overcome that difficulty by using three separate compressing units, so that when the demand for air was reduced at any time of the day they could shut down one of the units entirely or run it on "load or no load," whilst the two other units would continue to run at full load. That was the method by which the high-pressure plant was run. The 750-cub. ft. set was kept running at full load, so that the maximum efficiency was obtained; when the demand for air exceeded the capacity of that compressor the smaller one (a 200-cub. ft. set) was switched in, and when the demand for air was again decreased to within the capacity of the larger set to meet it, the smaller one was switched out. It was unnecessary, therefore, to waste air through a relief valve, or, alternatively, to run compressors at "load or no-load" for a considerable portion of the day. It was not at all easy, with electric drive, to arrange automatically the speed of the compressors to give an output corresponding with the varying demands on the system; with a steam plant that was more easily done, but the management of the average foundry would not think of putting in steam-driven compressors; that might be done at collieries where they used very large units indeed. The colliery people thought nothing of putting down a machine having an output of 7,000 or even 10,000 cub. ft. per min., but he did not know of any foundry having a compressor of a size approaching that.

MR. SHAW said he gathered it was the intention to install a large fan.

MR. BARLEY replied that, instead of having one fan to each set, they would have one fan for the two.

MR. SHAW did not agree with that arrangement, because it was such a serious matter to have the two sets out of action at one time.

MR. BARLEY pointed out that they were not putting down a Tilghman system, and that as the shot and sand did not pass through the fan the liability to break down would be minimised.

Overcoming Condensation Troubles.

The installation of a large-bore pipe had no effect whatever on the quantity of the condensate; the only advantage was that, by reason of the reduced velocity at which the air travelled through the pipe, the water was dropped in the pipe instead of being carried forward to the machines, *i.e.*, the tools. The system at his works was to put a "T" into the air main at every point at which there was a tool operating off the main. The "T" stood upright, and at the top of it there was a blank flange, into which the pipe connecting with the tool was screwed. At the bottom there was a syphon piece, exactly as used in town's gas installations. The water collected in the large main and was drawn off through special syphons at different points; from the small pipe there was a further condensate going down into the syphon pipe at the bottom of the "T," which latter prevented most of the water going over to the tool. Possibly a certain amount of the water went over, but there was not enough of it to cause trouble—and that was the result desired. At the beginning of each day the operator opened the cock at the bottom and blew off all the water in the syphon, and it was the duty of the millwrights to blow off the water from the large main every morning. Since these methods were adopted there had been no complaints at all of nuisance due to water.

Air Drying Deemed Too Expensive.

Dealing with Mr. Deschamps' question as to whether it would be advantageous to use an air drier, he said that he personally believed it would be, but on examining the matter very carefully he had concluded that the cost of putting in an air drier, which was worth while—and the one he had had in mind was one using silica gel—was practically prohibitive; therefore, he had dropped the idea of using an air drier and had decided to have the larger main and the syphoning arrangement.

The oil purifier used at the works, unfortunately, worked intermittently. When he had installed compressors he had had no idea of the importance of having the oil always in a purified state; if he had to install further compressors—and he hoped to do so this year—he would arrange to have an oil purifier in circuit, so that a pure condition of the oil was constant, apart from the bearings. Impure oil also affected the valves, of which there was a large number on a large compressor—on the 750-cub. ft. set at his works there were 12—and if those valves became carbonised their efficiency was reduced very quickly.

With regard to measuring instruments, unless they were used for measuring the air output

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* Published in this issue, page 39.

and the power input, one could not know exactly what the efficiencies of the machines were; one would know, of course, when they became palpably inefficient, but in the meantime a quantity of money might be wasted through inefficient working.

Relative Cost of H.P. and L.P. Air.

As to the efficiency of the low-pressure and the high-pressure plants, he said he had avoided mentioning the makers' names as far as possible, in the interests of fairness. The high-pressure plant was of the very highest class; if it were not the best compressor that could be purchased, it was among the best, and he did not think there was one on the market which was in any sense superior, whether made in England or elsewhere. The low-pressure compressors were supplied by the best-known makers of sand-blast apparatus certainly in this country, if not in the world, and presumably, therefore, they had supplied what they believed to be the best machines for the job. When he had commenced to take measurements he had found, to his astonishment, that it was costing more to compress to 30 lbs. than to 100 lbs. per sq. in. Further, when one took into account the fact that the load factor on a shot-blast plant must obviously be very much better than it could ever be on a high-pressure plant in a steel foundry—which had to supply innumerable small tools, coming on at all times of the day without any warning, so that at one time of the day it might be working on a 100 per cent. load factor, and at another time one might not know what to do with the compressed air available—one would appreciate that the efficiency of the shot-blast plant should be considerably higher than that of the high-pressure plant; he considered that it should be about 50 per cent. better, but it was not. The feelings of the makers could be gauged by the fact that they had offered to put one of their low-pressure machines on to the same bedplate and guarantee an output of 1,000 cub. ft. per min., using the same motor as is used at present, to produce 600 cub. ft. of air per min. with the existing compressor. So far as he knew, his firm were so satisfied with that offer and with their own tests that they were going on with it.

Reducing the Presence of Compressed Air.

Replying to Mr. Lucas, he said it would be possible to install a plant to compress to 100 lbs. per sq. in. and to reduce the pressure down to 30 lbs. per sq. in. for sand-blasting, but it was questionable whether it would be expedient to do so, because his experience was that the volume of air required for sand-blasting was about three times that required for high-pressure work, and, therefore, it might pay to install two compressors. It depended entirely on the quantity of air required. A further difficulty, from an engineering point of view, was that when the pressure was reduced there would be a good deal of condensate, because immediately the air was expanded the moisture dropped out.

Size of Main.

He could not say off-hand what size of main should be used for a given volume of air, but Messrs. Consolidated Pneumatic Tools published a handbook containing a table giving the appropriate sizes of mains for passing given volumes of air at given velocities. When one had decided upon the velocity that suited one's conditions best, one could use that table.

Central or Decentralised Plants.

As to the relative efficiencies of central and separate plants, he said that the portable compressors used for supplying concrete breakers were quite close up to the tools, so that it was obvious that, physically, they were not losing anything by drop in the temperature of the air. Of course, when air was compressed, heat was produced. In the case of the high-pressure compressors at his works, which were intercooled, the average final temperature for the quarter ended December last was 269 deg. Fah. The final temperature gave some idea of the efficiency of the machines, and in the low-pressure sets at his works it was very rarely below 300 deg. The explanation was that unless there was the minimum clearance between the piston and the cylinder there would be a lot of inert air in the machine; one did not get rid of all of it when the piston came to the end of its stroke and the valves opened. If there were a lot of residual air present, then obviously the machine was doing work over and over again, and therefore the temperature rose. That simple fact explained the marked differences in the efficiency of one compressor as compared with another. In respect of the low-pressure machines at his works he had conceived the idea that if he could apply to them some of the outstanding features of the high-pressure sets he could improve their efficiency at comparatively small cost. The first thing to be tackled were the pistons. There were several means of sealing the piston in the cylinder of an air compressor. Some people adopted Ramsbottom rings, but the trouble with that sort of thing in a compressor was that, although there might not be any leak past the ring itself and the cylinder wall, undoubtedly there could be a leak round the back of the ring. The high-pressure machines at his works were fitted with rings, having in each case a spring fitted which pressed the ring tightly against the grooves in the vertical direction, so that, if the spring were properly adjusted, it was impossible for air to escape there. The gain in efficiency resulting from the fitting of these rings to the low-pressure compressors was only 3 or 4 per cent. By fitting improved valves a little further gain was secured, but it was not very much, and it was very difficult to determine, without studying closely the measurements and designs, what was wrong. It was eventually found, however, that the principal difference between the two designs was in the clearance space between the top of the cylinder and the piston head; that meant that there was a difference in the volumetric efficiency, and that was the gist of the whole thing. Therefore, there was no reason why a low-pressure plant should be less efficient than the high-pressure plant; indeed, it ought to be more efficient. It was entirely a matter of engineering. Mr. Deschamps had stated that he could compress air in his low-pressure set at half the cost of compressing in the high-pressure set; that was right relatively, but before he (Mr. Barley) could say that Mr. Deschamps' low-pressure set was better than his he would want to know how many units of electricity were put into it to compress a given quantity of air.

Mr. Deschamps said that he got a better ratio than did Mr. Barley.

Mr. Barley replied that, on the other hand, his low-pressure set might be as good as Mr. Deschamps', and his high-pressure set considerably better.

Overcoming Leakage Troubles.

With regard to loss of air when it had to travel long distances through pipes, he said there was no reason why an air main should not be as tight as any other main; it was just a matter of correct fitting. Of course, the average fitter, when fitting up a steam main, did what he thought was reasonably right, and hoped that before very long the steam would put any small leaks tight. In some instances it did, but in others it did not, and when the foreman complained about leakage, the fitter would caulk or re-pack the joints where the leakage had occurred. The trouble with compressed air was that one might not notice any leaks that occurred, in the ordinary way, because the only indication of a leakage was a slight noise made by the escaping air, but if proper methods of measuring were adopted, the records would indicate any leakage. If proper care were taken to prevent leakage, then the only real loss to be contended with was that due to reductions of temperature, which, of course, resulted in an increase of the density of the air; some people adopted the expedient of after-heating. That was rather a theoretical than a practical matter, and he had not gone that far. On the other hand, since the plant had been centralised at his works, the costs for high-pressure air alone had been reduced by about £500 a year, and the service had been extended very considerably.

Converter Steel Castings.

The next Paper to be discussed was "The Preparation of the Metal for Steel Castings in the Converter,* by Mr. Léonard.

Mr. J. Deschamps said that at the beginning of the Paper the author had suggested that only pig-iron was used in the converter, for he had stated that the object of the operation in the converter was to produce liquid steel from liquid pig-iron. It should be pointed out, however, that in modern practice much scrap was used. He would like to know if the author's practice was to use hematite pig-iron only. Table I of the Paper showed that after the blow in the converter the carbon content of the steel was 0.2 per cent., the silicon content was 0.1 per cent., and the manganese content 0.2 per cent. Those figures seemed to indicate that the blow was stopped before the completion of the operation, because if he had carried the operation through to completion, the carbon content and the manganese content would have been about 0.05 per cent. He would like to know whether the members generally considered it a dangerous practice to stop the blow before oxidation was complete, because it meant that one had to judge, from the aspect of the flame, the amount of carbon present, which was the most important element left in the metal; one needed extraordinary skill to be able to do that, and much depended upon one's physical condition when making the test. (Laughter.) The figures indicating the number of calories evolved by the conversion of 1 kg. of carbon, silicon and manganese appeared to be inaccurate. Whereas the author had stated that 8,100 calories were evolved by the conversion of 1 kg. of carbon burning to CO^2, he (Mr. Deschamps) calculated the amount of heat as 9,440 calories, basing his figure on the assumption that the carbon was burned to the extent of only one-third to CO^2, and two-thirds to CO, as evidenced by the fact that the gases were only in flame at the mouth of the converter. It should burn inside in order to yield its heat to the metal. If the author's figures were accepted as correct, it would appear that more heat was evolved from the combustion of carbon than of silicon; that was against all accepted ideas in practice, however, which were that the silicon was the element which yielded the maximum number of calories.

Oxidation Losses Queried.

Again, he calculated that the silicon reaction yielded 17,225 calories, which was very different from the author's figure. Perhaps this was a somewhat academic point, but the figures given in the Paper were very much against accepted ideas, and it would be helpful to have other opinions as to the accuracy or otherwise of the figures. The author had stated that for the operation in the baby converter Howe Hall estimated the conversion loss to be from 16 to 18 per cent. That was greatly in excess of what could be achieved in modern practice; the loss in the converter itself should not be more than 9 or 10 per cent.

Mr. William Shaw: What about the cupola?

Mr. Deschamps replied that the total loss, from cupola charge to finished steel, should not be more than 12½ per cent.

Influence of Hot Cupola Metal.

One of the most interesting items in the Paper was the diagram in Fig. 2, showing the effect of

* Published in our issue of June 19, page 458.

starting with very hot metal tapped from the cupola before the conversion took place. In such a case the whole of the carbon was eliminated before the manganese was eliminated to any extent. That also was against accepted ideas, but he supposed it must be correct. If that were so, then more manganese was left at the end of the blow, and the author claimed it to be an advantage because the manganese would be used to deoxidise the metal. That must be wrong, however, because surely the manganese was present as MnO, and, therefore, would not be able to deoxidise the metal further.

Calories Evolved in Question.

MR. E. J. BROWN said he believed that with regard to the molecular heat of formation of the carbon the author of the Paper was correct; obviously he had taken the figures from Richards' "Metallurgical Calculations." With regard to the silicon, however, Mr. Brown could not digest the author's figure of 6,429 calories per kg., but he had referred to the 1910 edition of Richards' book and had found that the figure was exact—the molecular heat of formation given in that book being 180,000. In the 1918 edition of Richards' book, however, the figure was 196,000, which brought the heat of formation of the silicon to 7,000 calories per kg., and he believed that was the latest figure. It was very important that these figures should be correct, or as nearly correct as possible, and for that reason he had appreciated the remarks made by Mr. Deschamps. With regard to the burning of the carbon, he recalled that some years ago, in collaboration with others, he had made quite a number of gas analyses, and had found that, as everybody knew perfectly well, not all the carbon was burned directly to CO^2; he had found as much as 20.7 per cent. of CO in the gases. The samples of gases were taken at regular intervals and the curves obtained were plotted very carefully, and it was found that obviously the heat efficiency loss was very great. The problem of the action and reaction undoubtedly was extremely complicated. There were matters such as affinity, mass reaction and so on to be considered, and it was extremely difficult to dogmatise on the subject, but he had found that a very heavy oxidised slag was produced in the course of the blow. There was a quantity of FeO. The process proceeded more or less in cycles; it was a slag reaction, *i.e.*, the FeO acted with the carbon, and one checked the blast, according to the author's statements, in relation to the viscosity and the composition of the slag. The Paper was written very ably, and it was well worthy of the records of the Institute.

MR. DESCHAMPS said that his authority for the figures he had given concerning the heat of combustion of silicon was a book by Greenwood and Sexton—two British authors—but it was published in 1905, so that it was more ancient than Richards' "Metallurgical Calculations." With regard to the manipulation of the converter, Mr. Léonard favoured only the manipulation of the blast, and was not in favour of altering the angle at which the converter stood during the blow. His (Mr. Deschamps') experience, however, was that much better results were obtained, so far as metal loss was concerned, by manipulating the angularity of the converter, irrespective of the blast. He had found that he could reduce considerably the metal loss by starting the blast with the tuyeres flush with the level of the bath, then inclining the converter, when the manganese boiled, so that the tuyeres dipped about an inch, and then to 2 inches at the last stage of the blow. By working on those lines he had reduced the metal loss on conversion from about 12 or 13 per cent. to 9 or 9½ per cent. constantly.

The CHAIRMAN (Mr. Harley) did not think much importance attached to Mr. Deschamps' criticism of the author's statement that the object of the operation in the converter was to produce liquid steel from liquid pig-iron; probably, of course, the liquid iron in the converter was made originally from pig-iron and steel scrap. With regard to the figures in Table I, he said that if they represented the composition of the steel at the end of the blow, and before any additions were made, then the author's experience was contrary to his own. The composition given, in respect of the carbon, was that of mild steel. The general practice in this country, he believed, was to blow right down practically to a finish and make additions afterwards, for the simple reason that, as Mr. Deschamps had said, it was very difficult to stop the blow when the carbon content was 0.2 per cent. He wondered whether there was an error in the position of the decimal point. A loss of only 9 per cent. on conversion, as obtained by Mr. Deschamps, was remarkably low; it proved that his practice of adjusting the angle of the vessel was good. It was his own practice to manipulate the vessel, but the percentage of loss was rather higher than the figure given by Mr. Deschamps. The loss of 3½ per cent. in the cupola was normal. There seemed to be some confusion with regard to the heat evolved in the conversion process. Theoretically, this could be calculated with great exactness, but the conversion was complicated in practice by other factors. The Paper was one which stimulated thought and research into the operations in the side-blown converter, and, whether one agreed or not with the conclusions of the author, one would profit considerably by a careful study of the Paper.

(Mr. Léonard was not present at the meeting, but it was intimated that he would probably reply to the discussion in writing.)

The Side-Blown Converter.

The final Paper to be taken was "The Future of the Side-Blown Converter in the Steel Foundry,"* by Mr. J. Deschamps.

Fluidity of Steel.

MR. V. STOBIE (Junior Vice-President) said there were statements in the Paper which were difficult to reconcile one with the other. It was stated that the use of the side-blown converter was advantageous because of the fluidity of the steel it produced. He believed it was generally admitted that the great fluidity of converter steel was due to oxide of iron in the steel, but the author had stated in the Paper that the special process he had devised for converter practice resulted in the elimination of all oxides, and it would be interesting to know how the fluidity associated with converter steel was maintained when the oxides had been eliminated. As an example of the influence of oxides, Mr. Stobie recalled an occasion on which, when making a 4-ton casting with electric steel, a foreman had under-estimated the quantity of metal required to the extent of half a ton, and the extra half-ton, which was required for the head, had to be obtained from an electric furnace other than that in which the original steel was melted. The other metal had, at the time, reached the condition in which it had just been slagged, *i.e.*, it was well melted and well oxidised, and had not started to deoxidise. The temperature of this steel was considerably lower than the usual tapping temperature of an electric steel, but it was taken from the furnace in that condition and, after ferro-silicon had been added as in converter practice, put into the head section of the casting, and ran as well as any converter steel. It was not a steel which could be regarded as an electric steel, because it had not the properties associated with thoroughly deoxidised steel.

Commenting on the statement in the Paper to the effect that one of the factors to be considered when deciding whether or not it was advisable to install a converter was the class of castings to be produced, he suggested that that statement qualified the whole of the Paper. If one were satisfied with the manipulative qualities and the fluidity of converter steel, as a primary consideration, then it appeared unnecessary to produce the high quality associated with electric steel, absolutely deoxidised, and which was not so fluid.

* Published in our issue of July 3, page 14.

Open-Hearth Steel Prepared.

MR. WILLIAM SHAW asked if there were any great advantage or disadvantage in using excessively fluid steel for making castings with varying thicknesses of section, such as were met with in everyday practice. He was concerned with acid open-hearth steel, which had not excessive fluidity, but he maintained that one could make a better and sounder casting with steel made by the acid open-hearth process than with that made by the Bessemer process, because there were less difficulties at the junctions of the heavy and light sections—and that was a very important matter indeed.

The "Acid Test."

MR. DESCHAMPS, replying to Mr. Stobie, said that the question as to whether or not the fluidity of converter steel was achieved at the expense of oxidation was a very controversial one. He was not prepared to say that the extra fluidity was due to the presence of oxides, although it was the general explanation given; but, even assuming that that were so, the quality of the steel could only be judged by the results obtained with test-pieces cast with the castings produced with the steel, and with properly-made converter steel there was no difficulty whatever in meeting, and more than meeting, all existing specifications so far as physical properties were concerned. With a steel containing, say, 0.18 to 0.2 per cent. carbon, 0.6 to 0.7 per cent. manganese, 0.3 per cent. silicon, 0.05 or even 0.06 per cent. sulphur and phosphorus, and after a suitable annealing treatment—the standard treatment—there was no difficulty whatever in getting a tensile strength of 20 or 30 tons per sq. in., 35 to 40 per cent. elongation on 2 in., and 40 or 50 per cent. reduction of area, and every one of the test-pieces would bend over flat. Whether or not the steel contained oxides was immaterial, in view of the results obtained with it.

Replying to Mr. Shaw, he said the steel used for pouring a thick casting would not be so hot as that used for pouring a casting about ½ in. thick. He liked to make the steel hot, but when it was to be used for a heavy casting it was allowed to cool for a few minutes in the ladle before pouring. The optical pyrometer was the only practical instrument for ascertaining the temperature, but one could not measure the temperature of the metal at the top of the ladle owing to the presence of slag there, and it was of no use measuring the temperature in the jet of metal because by that time the metal was already poured. He would like to know whether anyone had found any reliable method of ascertaining the temperature of the metal before pouring into the moulds. This was an important matter, because he believed a good many wasters were produced because the steel was poured at the wrong temperature. One of the assets of the converter process was that the steel could be made very hot, so that it could be used for special purposes, whilst at the same time, if one did not need very hot metal it could be allowed to cool to a relatively low temperature. Thus it met the conditions referred to by Mr. Shaw.

Relative Merits of Various Processes.

The CHAIRMAN said that he was in favour of the converter, by reason of its flexibility, when the class of work to be done was such that converter steel was suitable.

MR. W. SHAW: Which converter?

The CHAIRMAN: The side-blown converter.

MR. SHAW: Which process?

The CHAIRMAN: The "Stock" process.

Naturally, continued the Chairman, if the class of work to be done did not demand that the

(*Continued on page 45.*)

Factors Affecting the Chilling Properties of Cast Iron.*

By A. L. Norbury, D.Sc.†

Introduction.

Exact knowledge regarding the chilling properties of the iron he is using is of the greatest importance to the founder. A founder making grey-iron engineering castings, for example, requires an iron which will produce castings which are free from mottle or hard spots, but which are nevertheless as close to the mottle as possible, since such castings have the closest grain and the greatest strength. A malleable founder, on the other hand, requires an iron which will give castings free from spots of grey iron, but which are as near to being spotted as possible, since such castings are most readily malleablised. The chilling properties of a cast iron are largely dependent on its chemical analysis, particularly on its silicon content, but it has been realised for many years that there was some other quality in an iron besides its chemical analysis which affected its chilling and other properties. For example, different results have been obtained from hot-blast and cold-blast, or all-mine and refined pig-irons, identical in chemical analysis, and even from different sized pigs from the same blast-furnace tap. It is only recently, largely owing to the very valuable work of Piwowarsky, Hanemann, Bardenheuer and others, that the reasons for such differences have become understood.

In the present Paper results are given which illustrate the differences in chilling properties that may be obtained from irons of the same chemical analysis, while other results illustrate the effect of total carbon, silicon, manganese and sulphur contents, and mould temperature on the chilling properties.

Effect of Melting Conditions on the Tendency to Chill

The fact that it is possible to get widely different chilling properties from melts of cast iron identical in chemical analysis, cast under identical conditions, can be demonstrated by superheating or prolonged heating of the melt, or by additions of steel, which can, without materially altering the chemical analysis, greatly increase the chill in the resulting castings.

The fractures of a series of test-bars illustrating this effect are shown in Fig. 1. Test-bars, 0.6 in. and 0.4 in. dia. and 16 in. long, were cast in green sand from a crucible melt of Swedish white iron, 40 per cent. ferro-silicon and 80 per cent. ferro-manganese, and showed grey fractures. The melt was then reheated at 1,300 deg. C. to 1,400 deg. C. in a coke furnace for about half an hour, stirred with a steel rod for 2 or 3 min., and a second set of bars cast. A third, fourth and fifth set of bars were then cast after reheating for about half an hour between each cast. The chemical analysis of the melt remained practically unaltered during the operation and the bars were all cast under identical conditions. It will be seen, however (in Fig. 1), that the fractures altered considerably, since in the third and fourth casts the 0.4-in. bars showed a mottled fracture, while in the fifth cast even the 0.6-in. bar was mottled, while the 0.4-in. bar was almost pure white. The mottled fractures are typical of irons which have been superheated or had steel additions, which are consequently one of the chief causes of inverse or internal chill. Test-bars 1.2 in. dia. cast at the same time as the 0.4-in. and 0.6-in. bars showed normal graphite and pearlite in the first cast and progressively finer graphite structures in each subsequent cast. The fine or "supercooled" graphite was associated with ferrite, which accounts for the combined carbon dropping from 0.75 in the first cast to 0.42 per cent. in the fifth cast.*

Exactly what happens to the molten iron during the above operation is difficult to demonstrate conclusively, but the explanation advanced by Piwowarsky, Hanemann, Bardenheuer and

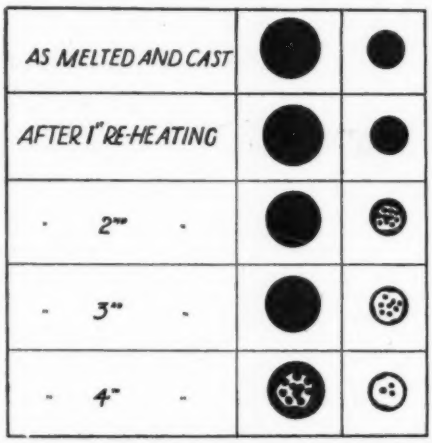


FIG. 1.—EFFECT OF REHEATING THE MELT AT 1,300 TO 1,400 DEG. C. ON THE FRACTURES OF 0.6-IN. AND 0.4-IN. DIAMETER TEST-BARS CAST IN GREEN SAND.

Chemical analysis unchanged during operation: T.C., 2.76; Si, 3.26; Mn, 1.00; S, 0.03, and P, 0.03 per cent.

others is that it is the presence or absence of minute particles of graphite in the melt which produces the above differences. If graphite particles are present they act as seeds or nuclei when the melt solidifies and initiate and facilitate the deposition of graphite flakes on solidification. If no such graphite nuclei are present the deposition of graphite does not start so readily and the melt cools to a lower temperature before the graphite starts to be deposited, with the result that the deposition tends to be incomplete and, moreover, the flakes are much smaller on account of the lower temperature at which they are deposited (*i.e.*, supercooling).

The effects of superheating, prolonged heating, and steel additions are consequently due to their action in dissolving graphite particles in the melt. The differences observed between hot-blast and cold-blast irons of the same chemical analysis may be explained in a similar manner in terms of graphite size. The smaller the flakes the more rapidly and more completely will they dissolve when the iron is remelted and cast in the foundry.

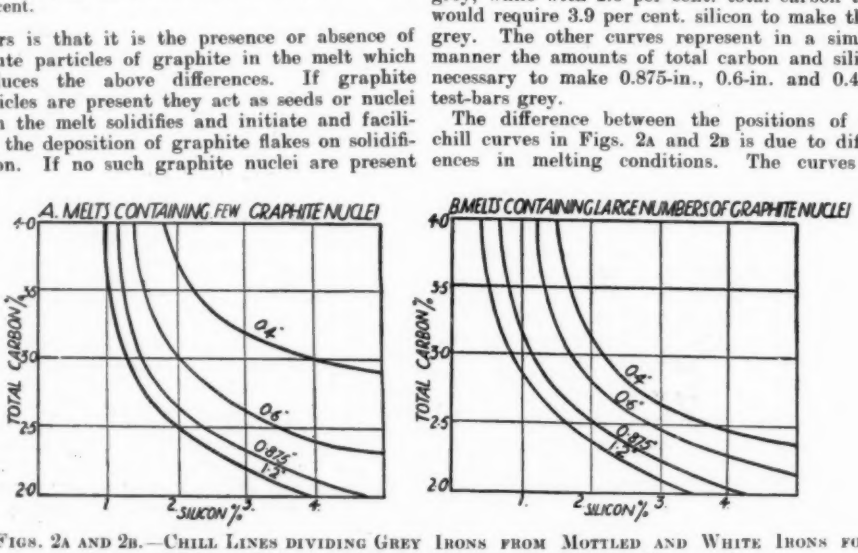
Effect of Graphitising Additions.

The converse effect to that produced by superheating and steel additions may be obtained by adding pigs containing coarse graphite flakes to the melt. If this be done to a superheated melt the reduction in chill is considerably greater than could be accounted for by the alteration in chemical analysis. Another method of introducing graphite nuclei into the melt is to add ferro-silicon or calcium silicide or nickel or other graphitisers. Such additions probably cause the precipitation of a large number of finely-divided graphite particles in the melt. One effect of their being so finely divided is that they are more rapidly redissolved on superheating than the smaller number of coarser particles produced by adding pig-iron. Another effect is that such particles produce a very uniform graphite structure in the iron if it solidifies grey. Grey irons produced in this manner, by the addition of graphitisers to melts containing few or no graphite particles, have high mechanical strength.

Effect of T.C., Si, and Melting Conditions on the Tendency to Chill.

The effect of total carbon, silicon and melting conditions on the tendency of various-sized round bars to chill is illustrated in Figs. 2A and 2B. The 1.2-in. curve in Fig. 2A indicates that 1.2 in. dia. sand-cast test-bars containing 4.0 per cent. total carbon would be mottled, or white with silicon contents between 0.0 and 1.0 per cent., and with higher silicon contents would be grey. With 3.0 per cent. total carbon they would require 1.3 per cent. silicon to make them grey, while with 2.0 per cent. total carbon they would require 3.9 per cent. silicon to make them grey. The other curves represent in a similar manner the amounts of total carbon and silicon necessary to make 0.875-in., 0.6-in. and 0.4-in. test-bars grey.

The difference between the positions of the chill curves in Figs. 2A and 2B is due to differences in melting conditions. The curves in



FIGS. 2A AND 2B.—CHILL LINES DIVIDING GREY IRONS FROM MOTTLED AND WHITE IRONS FOR 1.2-IN., 0.875-IN., 0.6-IN. AND 0.4-IN. DIAMETER TEST-BARS. CAST IN SAND.

Other elements present: Mn, 0.4 to 1.0; S, 0.03 to 0.08, and P, 0.03 to 0.30 per cent.

Fig. 2A were constructed from test-bars cast from melts which contained only a small number of graphite particles. Those in Fig. 2B were from melts containing large numbers of graphite particles, similar to the first cast in Fig. 1, while the melts in Fig. 2A were probably similar to the third cast in Fig. 1. The melts in Fig. 2A were crucible cast from mixtures of Swedish white iron (T.C. 3.7, Si 0.3 per cent.), Armco iron, 10 per cent. ferro-silicon, 80 per cent. ferro-manganese and 20 per cent. ferro-phosphorus. The Swedish pig-iron (melting point 1,130 deg. C.) and 10 per cent. ferro-silicon (melting point 1,200 deg. C.) melted

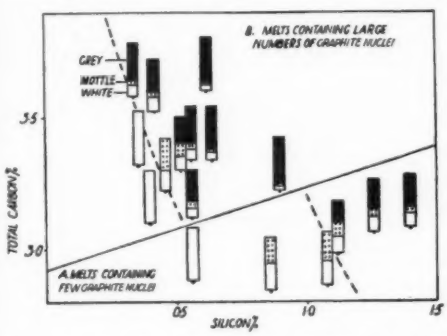
* Paper presented on behalf of the Institute of British Foundrymen to the Pan-European Foundry Congress, Liége, June, 1930.

† British Cast Iron Research Association, Birmingham.

* Further information is given in "Constitutional Diagrams for Cast Irons and Quenched Steels," Iron and Steel Institute, 1929 (I), and "The Effect of Melting Conditions on the Microstructure and Mechanical Strengths of Grey Cast Irons containing Various Amounts of Carbon and Silicon," Journal Iron and Steel Institute, 1930 (I).

first and alloyed, then the Armco iron (melting point about 1,500 deg. C.), which lay at the bottom of the melt, gradually dissolved in it, with the result that most of the graphite particles in the melt were dissolved.

For the melts in Fig. 2B, on the other hand, 40 per cent. ferro-silicon, instead of 10 per cent., was used, and was not added until the Swedish iron and Armco iron had melted and alloyed. On adding the 40 per cent. ferro-silicon (melting point about 1,400 deg. C.), it floated on the surface of the melt; the latter was then reheated, and when the ferro-silicon was almost



FIGS. 3A AND 3B.—FRACTURES OF 5-IN. BY 5-IN. BY 1-IN. TEST-PIECES CAST ON CHILLS.

Other elements present: Mn, 0.03; S, 0.03, and P, 0.03 per cent. Total-carbon and silicon contents are indicated by the position of the dots.

molten it was stirred into the melt, which was then poured immediately. Consequently, there were large numbers of finely-divided graphite particles precipitated in the melt by the 40 per cent. ferro-silicon.

The difference in the chilling properties of the irons in Figs. 2A and 2B is very marked. For instance, in Fig. 2A, with 3.0 per cent. total carbon, no less than 4.0 per cent. silicon is required to make the 0.4-in. bar grey, while in Fig. 2B only 2.2 per cent. silicon is required. Even greater differences would have been obtained if the melts in Fig. 2A had had still fewer graphite particles present.

The results of another series of tests are shown in Figs. 3A and 3B. In these tests 5-in. by 5-in. by 1-in. test-pieces of iron were cast in green sand on to cast-iron chills. The depth of chill on the fractured test-piece is indicated in Figs.

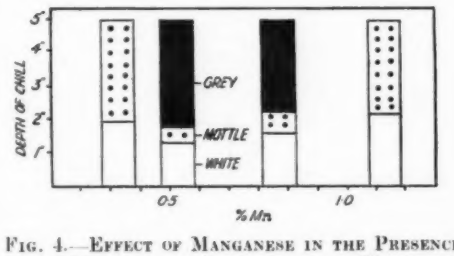


FIG. 4.—EFFECT OF MANGANESE IN THE PRESENCE OF 0.14 PER CENT. SULPHUR ON THE FRACTURES OF 5-IN. BY 5-IN. BY 1-IN. TEST-PIECES CAST ON CHILLS.

Other elements present: T.C., 3.2; Si, 1.1, and P, 0.03 per cent.

3A and 3B above the point indicating the percentage of total carbon and silicon in the cast. The irons in Fig. 3A were made in a similar manner to those in Fig. 2A, that is to say, they only contained a few graphite nuclei in the melt. Those in Fig. 2B (which were cast by Mr. E. C. Dickenson, B.Met., for the Association) were made in a similar manner to those shown in Fig. 2B.

Comparing the irons in Figs. 3A and 3B, and making allowances for differences in chemical analysis, it is evident that the irons in Fig. 3A gave much deeper chill than irons of the same chemical analysis in Fig. 3B.

Effects of Mn, S and P.

Manganese and sulphur separately each increase the tendency to chill, but a complication occurs when both are present (as is almost invariably the cast in cast iron), since they neutralise one another by forming MnS. An excess of manganese to the extent of about 0.3 per cent. manganese, in excess of the theoretical amount required to form MnS is, however, required to neutralise whatever sulphur is present.* Chill tests illustrating this are shown in Fig. 4

Published evidence regarding the effect of phosphorus on the tendency to chill is conflicting. Some evidence has, however, recently been obtained which suggests that phosphorus decreases the tendency to chill on thin sections of sand castings, although the effect is not very marked. Amongst other elements, Al, Ni, Co and Cu reduce the tendency to chill, while V,

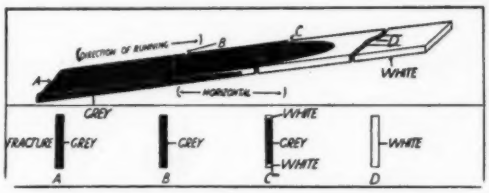


FIG. 5.—GREEN-SAND CHILLING PREVENTED BY MOLTEN METAL PASSING OVER AND HEATING THE MOULD.

Test-bar, 1 in. by ⅛ in. by 18 in., run uphill from lower end.

Cr, Se, Mo, Sn, Sb and W increase the tendency to chill.

An Illustration of Green-Sand Chilling.

An illustration of chilling in a green-sand mould is shown in Fig. 5. The test-bar shown was run uphill from the lower end and the passage of the molten metal heated the lower part of the mould and prevented the iron, which eventually solidified there, from solidifying white, whereas in the top end of the bar the green sand cooled the metal sufficiently rapidly to make it solidify white. The above principle is frequently applied in the foundry to eliminate chill in castings by altering the positions and sizes of the runners and risers.

Steel-Founders' Problems.

(*Concluded from page* 43.)

temperature of the metal should be such as could be obtained in the converter, he would use the furnace which would produce metal suitable for his work at the lowest cost. There were certain classes of work for which one would not use either a converter or an electric furnace.

The Chairman then read a letter, received from Mr. Davis (a member of the Institute), of Australia, asking whether converter steel castings were used largely in British railway rolling stock, or whether electric-steel castings had replaced them.

MR. DESCHAMPS said that last year, at his works, between 3,500 and 3,700 tons of locomotive castings were made by the converter process for the home railways. Every one of the castings had to meet the specification, and was subjected to the railway companies' inspection.

The CHAIRMAN asked how many tons of steel castings supplied to the railway companies were made of electric steel.

MR. DESCHAMPS said there were very few.

A speaker added that the British Standard Specifications could be met comfortably by converter steel, and the railway companies would see to it that they were met.

The CHAIRMAN asked if that statement were made as an argument that converter steel was superior to electric steel.

The speaker: Not necessarily.

The CHAIRMAN said that he could meet the highest specification produced for the highest class of work in light castings with converter steel.

A speaker said that if he were a railway inspector, or was responsible for the specification, he might call for electric steel, but the position was that one could confidently meet the railway companies' specification with converter steel if it were convenient to use a converter.

MR. W. SHAW pointed out that when one mentioned converter steel one should mention the "Stock" process. With that process one had not the difficulties of getting the material through the cupola to begin with, for one started with refined iron.

The CHAIRMAN agreed that the conditions of the "Stock" process were convenient. Mr. Deschamps used a cupola.

MR. T. W. BARLEY said that his firm had been meeting railway companies' specifications, and Admiralty and other Government specifications, with converter steel for the past twenty years or so—he had not personal knowledge of what was done more than twenty years ago because he had not been with the firm then. They had electric furnaces as well as converters, but the bulk of the steel was obtained from converters.

MR. V. STOBIE pointed out that the Sarupshand Steelworks, in Calcutta, which made nothing but railway material, used nothing but electric furnaces for producing the steel—and they had to sell their products in a competitive market. It might be that the specifications of the railway companies in Great Britain were such that they could be met by—to put it at its highest—a cheaper method of making steel. In comparing the different processes, however, one should have regard not merely to manipulation and the cost of the steel produced, but also to the quality of the steel; if quality had to be eliminated from the argument, then he had nothing more to say.

A speaker asked which process Mr. Stobie would advise for the production of high-quality steel as a commercial proposition.

MR. STOBIE said he would favour the electrical process.

MR. DESCHAMPS said the question was how the quality of the steel was to be measured, and his point was that it should be measured, not by chemical analysis, but by physical test. If converter steel gave physical results as good as those of other steels, what was the matter with it?

The CHAIRMAN asked if Mr. Stobie claimed that decidedly higher quality steel could be produced from an electric furnace than from a properly-conducted converter.

MR. STOBIE replied that he had never worked a converter, but he knew of a firm in Sunderland which had used a Tropenas converter, but had since installed an electric furnace because the best results were not obtained with the converter. That might have been due to faulty working of the converter, although he did not think so, but the fact was that, although the head of the firm had said that he would keep the Tropenas plant for six months after the electric plant had been installed, as a precaution, it had been scrapped within two months.

The CHAIRMAN said that he could counter that by another experience. He had wished to install an additional converter, and, being unable to wait until one could be made for him, he had bought one secondhand from a firm in Sheffield. The firm in question told him that he could have it with pleasure, but that he would never make any decent steel from it. Within a month, however, he was producing high-class steel with it. Such experiences as had been referred to, therefore, did not lead one anywhere.

The proceedings of Session B then closed.

* Further information is given in "Manganese in Cast Iron." Proceedings of Institute of British Foundrymen, Vol. XXII, or FOUNDRY TRADE JOURNAL. August 1 and 8, 1929.

The Economic Utilisation of British Pig-Iron Resources.

(*Continued from page 30.*)

District "B"—West Cumberland.

Index No.	Firm or Works.	Type.	Designation, Grade or Brand.		COMPOSITION. C. Combd.	C. Gr.	C. Total.	Si.	S.	P.	Mn.	Other Constituents.	Remarks.
13	UNITED STEEL CO.'S, LTD.	—	MOSS BAY, WORKINGTON	A	(Jan. 6, 1930.)	See Distington No. 15.		The same information would apply in respect of this (Workington) Branch.					
				R									
													Guaranteed Maximum. S / P
14	MILLOM & ASKAM HEM. IRON CO., LTD., MILLOM. (See also E. Lancashire.)	H	MH Special 0·02	A–R	0·25	3·75	(4·00)	1·5—2·5	0·015	0·020		Cu, trace	C·020 / 0·020
		H	,, Special 0·025	A–R	0·25	3·75	(4·00)	1·5—2·5	0·022	0·024	As reqd.	,,	0·025 / 0·025
		H	,, Semi-Special 0·03	A–R	0·25	3·75	—	1·5—2·5	0·026	0·025	from 0.15	,,	0·030 / 0·030
		H	,, Ord. Mixed Nos. 1, 2 and 3 Bess.	A–R	0·40	3·60	(4·00)	1·5—2·0 / 2·0—2·5	0·030 to 0·040	0·030	to 1·5%	,,	0·050 / 0·050
		H	,, Common 3	A–R	0·80	3·20	(4·00)	1·0—2·0	0·055	0·031	0·12—0·40	,,	—
		H	,, Ord. 4	A–R	1·00	3·00	(4·00)	0·70	0·075	0·031	0·12—0·40	,,	—
		H	,, Hard 5	A–R	1·45	2·20	(3·65)	0·60	0·115	0·031	0·12—0·40	,,	—
		H	,, Soft Mottled	A–R	2·16	1·70	(3·86)	0·50	0·120	0·031	0·12—0·40	,,	—
		H	,, Hard Mottled	A–R	2·70	1·00	(3·70)	0·40	0·125	0·031	0·12—0·40	,,	—
		H	,, Spotted White	A–R	3·40	0·30	(3·70)	0·33	0·130	0·031	0·12—0·40	,,	—
		H	,, White	A–R	3·59	0·06	(3·65)	0·20	0·156	0·031	0·12—0·40	,,	—
			M.H.M. (Small Pigs)—										
		R	Grey	A–R	0·84	2·78	3·62	1·0—1.8	0·10—0.16	0·05	0·23	—	Typical and approximate analysis only.
		R	Soft Mottled	A	1·73	1·75	3·38	0·84	0·15	0·07	0·23	—	
		R	Hard Mottled	A	2·62	0·72	3·34	0·74	0·15	0·075	0·23	—	
		R	Spotted White	A	2·83	0·55	3·38	0·65	0·16	0·08	0·21	—	
		R	White	A	2·82	0·08	2·90	0·56	0·18	0·08	0·21	—	
												As	Fe× diff.
15	DISTINGTON HEM. IRON CO., LTD.	H	"SPECIAL DISTINGTON" ..	A	0·20	3·78	3·98	2·50	0·014	0·020	0·50	—	92·986 —
			,, ,, ..	R	Nil—0·5	3·4—4·0	3·5—4·0	2·0—4·0	0·01—0·02	0·02—0·03	0·30—1·00	Traces—0·03	— —
		H	"ORDINARY DISTINGTON"	A	0·20	3·78	3·98	2·50	0·014	0·045	0·50	—	92·961 —
			,, ,, ..	R	Nil—0·5	3·4—4·0	3·5—4·0	2·0—4·0	0·01—0·03	0·03—0·045	0·30—1·00	Traces—0·03	— —
		R	D.T.N. Refined for Malleable ..	A	3·2	Nil	3·2	0·60	0·13	0·05	0·20	—	95·813 —
			,, ,,	R	3·0—3·2	Nil—0·5	3·0—3·6	0·5—1·00	0·10—0·15	0·05—0·06	0·15—0·30	—	— —
16	WHITEHAVEN HEM. IRON CO., LTD.	—			No reply. Not in blast September 30 or December 31, 1929.								

District "C"—Durham and Northumberland.

17	DORMAN LONG .. (See also Section "D" No. 26.)		CLEVELAND:—										
		H	"Clarence" Brand No. 1 ..	A–R	0·15	3·30	(3·45)	2·9	0·03	1·0—1·5	0·60	—	Cleveland. "Graded by fracture. Approximate analysis."
		H	,, ,, ,, 3 ..	A–R	0·27	3·01	(3·28)	2·6	0·036		0·58	—	
		H	,, ,, ,, 4 Fdy.	A–R	0·48	2·80	(3·28)	2·31	0·07		0·50	—	
		H	,, ,, Sil.	A–R	0·03	3·12	(3·15)	4·0—5·0	0·026		0·67	—	
			SPECIAL:—										
		H	"Clarence" Brand Stock No. 1	R	—	—	—	1·0—1·5					
		H	,, ,, ,, ,, 2	R	—	—	—	1·5—2·0					
		H	,, ,, ,, ,, 3	R	—	—	—	2·0—2·5	0·02—0·06	0·4—0·6 and 0·6—0·8	0·8—1·2	—	—
		H	,, ,, ,, ,, 4	R	—	—	—	2·5—3·0					
		H	,, ,, ,, ,, 5	R	—	—	—	3·0—4·0					
18	CONSETT IRON CO., Consett, CO. DURHAM.	H	CONSETT No. 1 Special ..	A	0·15	3·35	4·00	3·5	0·04 max.	0·06 max.	1·00	Cu 0·025 max.	—
			,, ,, ..	R	0·12—0·2	3·77—3·9	3·89—4·1	3—3½ / 3½—4	0·02—0·04	0·052—0·06	0·8—1·20	,, 0·015—0·025	—

District "C"—Durham and Northumberland—*continued.*

Index No.	Firm or Works.	Type.	Designation, Grade or Brand.		COMPOSITION. C. Combd.	C. Gr.	C. Total.	Si.	S.	P.	Mn.	Other Constituents.	Remarks.
18	CONSETT IRON CO., Consett, CO. DURHAM —*continued.*	H	CONSETT No. 1..	A	0·25	3·9	4·15	2·5	0·04 max.	0·04 max. 0·05 ,, 0·06 ,,	1·00	Cu 0·025 max.	—
			,, ...	R	0·2—0·3	3·95—3·70	3·90—4·25	2—2½ 2½—3	0·025—0·04	0·01 per cent limits	0·8—1·0 1·0—1·5	—	—
		H	Chilling	A	0·8	3·1	3·9	1·25 max.	0·06	0·06 max.	0·9	—	—
			,, ...	R	—	—	—	1—1¼	0·05—0·07	—	—	—	—
		H	High Manganese ..	A	0·5	3·6	4·1	1·0 max.	0·05 max.	0·05	1·5—3·5 (0·5 limit)	—	—
			,, ,, ..	R	—	—	—	1·0—1·5					
		H	,, ,, ..	A	0·4	4·0	4·4	1·5—2·0 2·0—2·5	0·04 max.	0·05	1·5—3·5 (0·5 limit)	—	—
			,, ,, ..	R	—	—	—	2·5—3·0					
		H	HEMATITE No. 3	A	0·6	3·3	3·9	1·0—1·5 1·5—2·0	0·04—0·06	0·04 max. 0·05 max. 0·06 max.	1·00	—	—
			CONSETT Low Phosphorus—										
		H	Foundry No. 1	—	0·2	3·8	4·0	3·0—3·5	0·04 max.	0·5—0·7	0·9—1·1	—	—
		H	,, No. 3	—	0·25	3·9	4·15	2·0—3·0	0·06 max.	0·5—0·7	0·9—1·1	—	—
			ALL Iron stocked to LIMITS of	R	—	—	—	0·5	0·02	0·01	0·25	—	—
			e.g.	R	—	—	—	1·0—1·5	0·04 max.	0·04 max.	0·8—1·0	—	—
				R	—	—	—	1·5—2·0	0·06 max.	0·05 max.	1·0—1·25	—	—
19	PALMERS SHIPBUILDING & IRON CO., HEBBURN.		HEMATITE—										
		H	"Tyneside" No. 1	A	0·15	3·85	(4·00)	2·0—3·0	0·03	0·05	1·00		*Maker's remarks.*
		H	,, Mixed Nos. ..	A	0·27	3·65	(3·92)	2·0—3·0	0·05	0·05	1·00		Nearly all iron supplied to special analysis, particularly hematite.
		H	,, No. 3	A	0·35	3·45	(3·80)	2·0—2·5	0·06	0·05	1·00		One customer may require No. 1 Hematite with 2½ to 3 per cent. Silicon, another 2 to 2½ per cent.
		H	,, No. 4	A	0·55	3·10	(3·65)	1·50	0·07—0·12	0·05	0·90		Occasionally make limited quantities 3·0—4·0 per cent. Silicon.
		H	Special High Manganese ..	—	—	—	—	1·0—2·5	0·04	0·05	2·0—3·0		Combined Carbon and Graphite figures only approximate, not guaranteed.
			FOUNDRY (Cleveland)—										
		H	"Jarrow" No. 1	A	0·10	3·65	(3·75)	3·0—3·5	0·03	1·40	0·60		
		H	,, No. 3	A	0·30	3·25	(3·55)	2·5—3·25	0·05	1·40	0·55		
		H	,, No. 4	A	0·50	2·90	(3·40)	2·50	0·08	1·40	0·50		
		H	,, Forge	A	0·56	2·90	(3·46)	1·75	0·10	1·40	0·50		
		R	C.B. Refined	—	—	—	3·0—3·3	0·8—1·20	0·07	0·31*	0·90—1·15	—	Made in a cupola at approx. 1,400° C. Tensile strength 14—15 tons per sq. in. Made in sand-cast pigs, notched and broken to 18 in. × 4 in. × 3½ in.
			* Iron similar in other respects can be supplied with 0·05 to 0·06 per cent. Phosphorus.										
20	SOUTH DURHAM STEEL & IRON CO., W. HARTLEPOOL.		"S.S.F." PIG—										Blast furnaces have been out of blast for nearly 5 years.
		R	Cylinder	A	0·70	2·60	3·30	1·30	0·08	0·06	0·50	—	Analyses given are refined iron and only approximate, without guarantee.
		R	Chilling	A	0·70	2·60	3·30	1·00	0·08	0·06	0·50	—	The phos. can be increased if required.
			"S.C.M." (REFINED MALLEABLE), in Small Pigs—										
		R	Grey	A	0·75	2·60	3·35	1·00	0·14	0·06	0·45	—	
		R	Soft Mottled	A	1·20	2·10	3·30	0·80	0·14	0·06	0·45	—	
		R	Medium Mottled	A	1·78	1·50	3·28	0·75	0·15	0·06	0·40	—	Approximate figures, without guarantee.
		R	Hard Mottled	A	2·56	0·70	3·26	0·70	0·15	0·06	0·40	—	
		R	Spotted White	A	3·00	0·25	3·25	0·60	0·16	0·06	0·35	—	
		R	White	A	3·05	0·10	3·15	0·50	0·16	0·06	0·35	—	

Conditions in the Continental Iron and Steel Industry.*

REPORT OF THE BRITISH DELEGATION.

(*Continued from page 22.*)

GERMANY.

War and Post-War Position.

The Treaty of Versailles altered the basis of the iron and steel industry in Germany. In 1913 the total output of the German Customs Union, which included Luxemburg, comprised 19,300,000 tons of pig-iron and 18,900,000 tons of ingot steel. Under the Treaty of Versailles—which separated Luxemburg from the German Customs Union, placed the Saar under French control for a period of fifteen years, and detached Alsace-Lorraine and part of Upper Silesia from Germany—Germany lost some 80 per cent. of its production of iron ore, 42 per cent. of its production of pig-iron, 37 per cent. of its production of crude steel, and 34 per cent. of its production of rolled products. In addition to this loss, another very important result of the Peace Treaty was the dislocation of the commercial connections which had previously existed between the Rhenish-Westphalian metallurgical centres on the one hand, and Lorraine, Luxemburg and Silesia on the other. In 1913 the production of ore in Germany (including Luxemburg) was 35,000,900 tons. The output of Germany in 1928 was 6,300,000 tons.

The early post-war years were occupied with the task of transforming the industry from a war-time to a peace-time basis. During the inflation years (1920 to 1923) the metallurgical industries suffered considerably from the shortage of coal and coke. Then came the stabilisation of the currency, followed by a period of deflation, which gave rise to many serious difficulties. Before the Dawes Scheme had been accepted, a start had been made in the work of reconstruction by the re-introduction of the two-shift system for blast furnaces and steelworks, and the acceptance of lower wages by the workers. The abandonment of the control over the Ruhr industries in the autumn of 1924 and the beginning, by Germany, of the control of her own economic destiny, gave an impetus to the new movement towards recovery. The metallurgical industry had one great advantage in the enormous amount of reconstruction during the inflation period, with the result that the industry, as a whole, enjoyed the benefit of the most up-to-date plant and equipment. The information obtained in Germany, and the visits paid to the German iron and steel works, gave proof of this.

Labour Conditions.

It was found that, due to the situation in Germany as the result of the war, the shortage of money, the high rate of interest charged for money, and other factors, at the time of the visit to Germany there were about three million workers unemployed. As regards the metal industries, which includes engineering, it was ascertained that at the time of the Delegation's visit the percentage wholly unemployed was 14.1 and the percentage on short time was 16.1. The reason given by the employers and their organisations and by the trade unions for the unemployment was the serious competition in the world markets, especially by France, Belgium and Luxemburg. It was found on the information obtained that no foreign labour was employed in the iron and steel industry.

It was ascertained that the workers in the iron and steel industry were comparatively well organised.

The existence of representative trade unions in the German iron and steel industry, and of the conciliation and arbitration system, which is regulated by the Conciliation Order of October 30, 1923, and two Administration Orders dated December 10 and 29, 1923, results in collective bargaining and collective agreements more or less similar to those which exist in Great Britain. The Order of October 30, 1923, provides for two main organs of conciliation, Conciliation Committees and permanent conciliators. The Conciliation Committees are set up by the supreme State authorities in agreement with the Federal Minister of Labour. The committees consist of an independent chairman—appointed by the Supreme State authority after consultation with the economic associations of employers and workers within the area—and an equal number of representatives of employers and workers as assessors. The conciliation system is designed to deal only with collective labour disputes.

The systems of payment of the workers are more or less similar for all the iron and steel workers. In some cases an hourly or daily rate only is paid; in other cases there is a basic rate with a tonnage bonus interest in production.

Wages.

Germany, like Great Britain, has a highly-developed statistical service, which is centred in the Federal Statistical Office at Berlin. This Office has recently completed an inquiry into the earnings and hours of work in the German iron and steel industry, the results of which have been supplied to the Delegation. In addition, information as to wage rates and earnings were supplied by employers and their organisations and by the leading workers' trade union in the iron and steel industry in the Rhenish-Westphalian area.

From information as to wage rates and earnings supplied by employers and their organisations, and by the principal trade union in the iron and steel industry in the Rhenish-Westphalian area, it is possible to arrive at close estimates of the total average weekly earnings (including all piecework earnings and output bonuses) of skilled, semi-skilled and unskilled workmen at blast furnaces, steel-melting plants and rolling-mills at the present time. These are as follow: Skilled men, 70 mks. (68s. 6d.); semi-skilled men, 54 mks. (52s. 10d.); unskilled men (including pieceworkers), 48 mks. (47s.). Rate of exchange—20.43 mks. equals 20s.

After consideration of such information as is available as to the numbers and wages of all ages, the average normal weekly earnings of all classes of workpeople in the iron and steel industry of Germany are estimated at 52 mks., equivalent to 50s. 11d. No law exists with regard to family allowances. In Germany, however, the family-allowance system has been adopted in certain iron and steel districts. The districts in which family allowances are not in force are Saxony, Remscheid, Greater Ilsede and Peine. According to information obtained by the official inquiry, the family allowances paid in the iron and steel districts of Germany average 2.1 per cent. of the gross weekly earnings, or 1.16 Rmks. per capita per week and 2.2 Rpf. per capita per hour. Germany has a highly-developed State system of social insurances, *e.g.*, invalidity and old age, sickness, accident and unemployment insurance, together with an extensive system of poor relief.

Hours of Work.

In Germany the legal regulation of hours of work in industry is governed by so great a multiplicity of texts, both pre-war and post-war, that it is difficult to state briefly what is and what is not permitted. The underlying principle of the orders in force is that the normal working day shall be one of 8 hrs., but employers and workers—by collective agreement—may contract to work up to 10 hrs. a day.

In the different productive departments of the iron and steel industry in Rhineland-Westphalia the normal working hours, according to collective agreement, are as in Table I.

As regards other departments in the heavy iron and steel industry, the working hours vary from 48 to 57 a week. The legal provisions governing Sunday work in Germany are complicated. In Rhineland-Westphalia Sunday work is work performed between the hours of 6 a.m. Sunday to 6 a.m. Monday.

Information was obtained from the employers' organisations, from the trade unions and from visits to works as to the usual starting and finishing times in respect of each department in Rhineland-Westphalia, and the total average number of normal weekly hours. The following details include some of the information so obtained: As regards blast furnaces, the total average normal hours of work (8-hr. shifts over 7 days) are 56; basic Bessemer converter plant (6 p.m. Sunday to 6 a.m. Sunday), 52 hrs.; Siemens open-hearth (7 p.m. Sunday to 6 a.m. Sunday), 51¾ hrs., and (6 p.m. Sunday to 6 a.m. Sunday), 52 hrs.; preparatory workers in melting shop (2 p.m. Sunday to 6 a.m. Sunday), 53¼ hrs., and (5 p.m. Sunday to 6 a.m. Sunday) 52½ hrs.; and tilting furnaces (the usual practice is 6 p.m. Sunday to 6 a.m. Sunday, 52 hrs., but 8-hr. shifts can be worked over 7 days according to state of trade), 56 hrs.; rolling-mills (6 a.m. Monday to 6 a.m. Sunday), 48 hrs.

TABLE I.—*Hours of Work in German Iron and Steel Industry.*

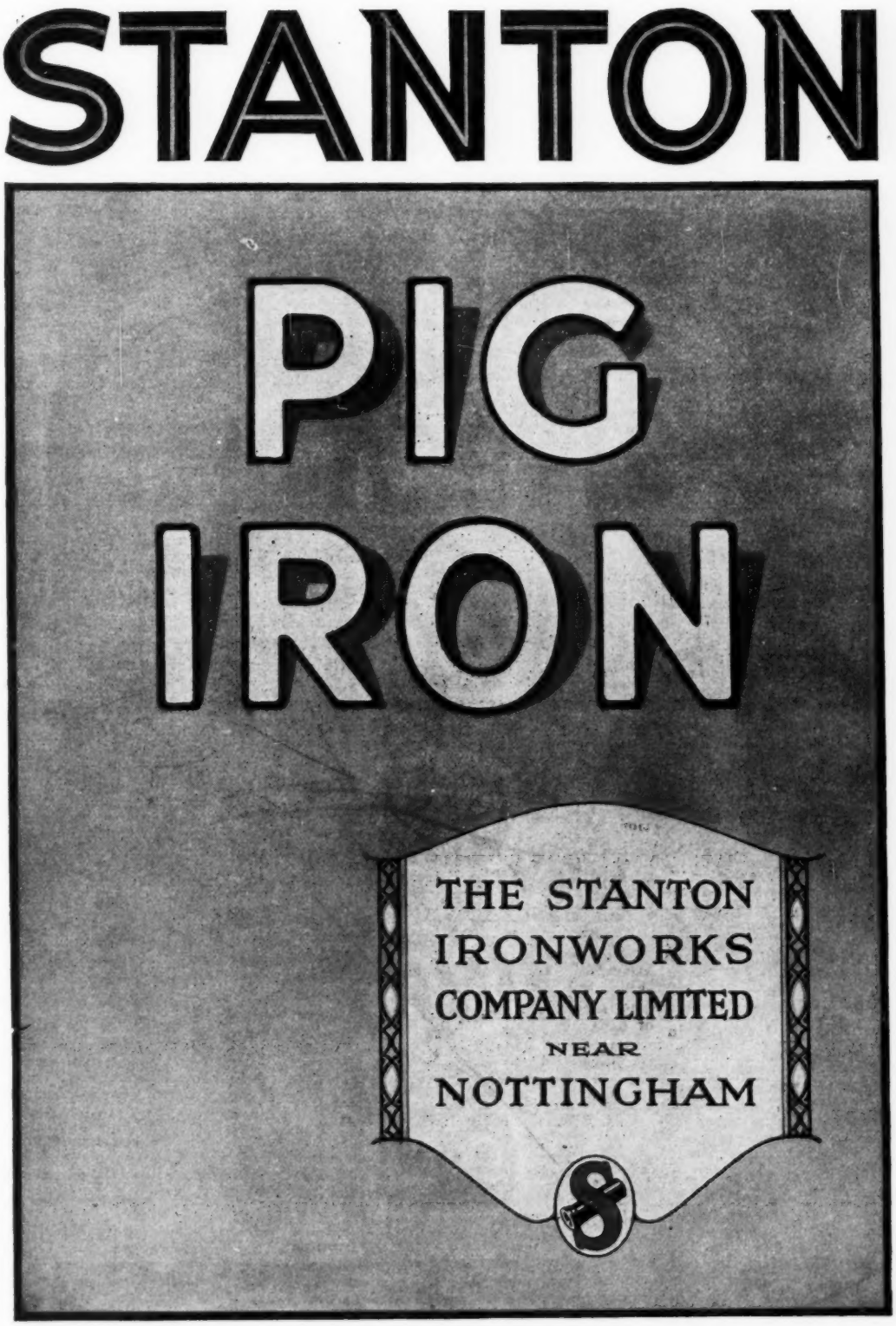
BLAST FURNACES AND COKE OVENS:—	
Workers protected by Order of January 20, 1925.	8 hrs. per day.
Workers not so protected, including workers in repair shops attached to the blast furnaces.	57 hrs. a week over the six weekdays.
BESSEMER AND OPEN-HEARTH STEELWORKS:—	
Workers protected by Order of July 16, 1927.	8-hr. shift. Three shifts.
Workers not so protected.	57 hrs. a week over the six weekdays.
HOT-ROLLING MILLS:—	
Workers protected by Order of July 16, 1927.	8-hr. shift.
Other workers.	57 hrs. a week over the six weekdays.

It was ascertained that the prevailing overtime extras were time and a quarter during the normal week; time and a half for work on Sundays. The overtime extra is paid on a weekly basis, and not on the basis of each day standing by itself.

(*To be continued.*)

B.S. Metric Conversion Tables.—The British Engineering Standards Association has issued comprehensive tables for converting inches to millimetres and millimetres to inches, covering both fractional and decimal subdivisions of an inch. The tables of inches give the conversions of every $\frac{1}{64}$ of an inch up to and including 12 in., whilst those for inches in the decimal system give the conversions of every $\frac{1}{1000}$ of an inch up to 1 in. The table of conversions of millimetres to inches gives the conversion of every millimetre from 1 to 1,000. A table is included giving conversion factors for linear, square and cubic measures, weights, stresses, pressures and weights per unit length for various measures common in engineering. Copies of the Tables (No. 350—1930) may be obtained from the Publications Department of the Association, 28, Victoria Street, London, S.W.1. Price 2s. 2d. post free.

* From the Report of the Economic Advisory Council Delegation on the Industrial Conditions in the Iron and Steel Industries in France, Belgium, Luxemburg, Germany and Czecho-Slovakia. Published by His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2, price 9d. each.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Trade Talk.

A Sheffield Trade Mission, headed by the Master Cutler (Mr. A. K. Wilson), will sail for South America on August 1.

The Leeds City Council have placed an order with the Brush Electrical Engineering Company, Limited, Loughborough, for 100 double-deck covered-top tramcars.

Mr. Job Holland, a former President of the British Refractories Association, recently opened the new laboratories of the Department of Refractory Materials of Sheffield University.

The Dinsdale Wire & Steel Company, Limited, is being wound up voluntarily. Mr. Ellis Hunter, of Messrs. Peat, Marwick, Mitchell & Company, Royal Exchange, Middlesbrough, is the liquidator.

The metallurgical workers at Ghent, who had been on strike since the beginning of June, have resumed work, the employers having agreed to a 2 per cent. increase in wages. About 4,000 workers have been idle.

Messrs. Swan, Hunter & Wigham Richardson, Limited, Southwick-on-Wear, have booked an order for a vessel of 3,400 tons for a Portuguese company. The engines will be supplied by the Neptune Works of the builders, Walker-on-Tyne.

On July 24 Messrs. Palmers Shipbuilding & Iron Company, Limited, Jarrow and Hebburn, will launch their 1,000th vessel, the ship being an oil tanker which is under construction at Hebburn for the Standard Oil Company, of America.

Messrs. High Duty Alloys, Limited, of 81, Buckingham Avenue, Trading Estate, Slough, inform us that they have recently extended their laboratory and added to their technical equipment. A fatigue-testing machine and an X-ray plant have been installed.

The Federation of British Industries is to ascertain the views of its members "as to whether or not a more general application of safeguarding duties would contribute materially to the restoration of prosperity to British industry and a consequent alleviation of the unemployment problem."

The partnership between Messrs. G. A. Foster, H. A. Foster, W. F. Foster and A. J. Foster, carrying on business as metal merchants at Fox Lane and Station Road, Chertsey, under the style of Amos Foster, has been dissolved. Messrs. G. A. Foster and A. J. Foster are continuing the business.

The ascertained price of No. 3 Cleveland pig-iron for April, May and June, 1930, is 65s. 9.99d. per ton, compared with 68s. 11.68d. per ton in the first quarter of the year. This means a reduction in blast-furnacemen's wages of 3 per cent., which will reduce them from 14.75 per cent. above standard to 11.75 per cent. above the standard.

A message from Sydney, N.S., states that the receivership of the Dominion Iron & Steel Company, Limited, has terminated in accordance with the ruling of the Supreme Court of Nova Scotia, and the new company (the Dominion Coal & Steel Corporation, Limited) has formally taken over the operations of the steel plant at Sydney.

Messrs. Metropolitan-Vickers Electrical Company, Limited, of Trafford Park, Manchester, announce that a new depôt at Mervyn House, Frederick Street, Cardiff, has been opened for the sale of their "Cosmos" lamps in the Cardiff district. Sales in the Swansea area will be conducted from the company's existing offices at 62, Wind Street, Swansea.

Messrs. Vickers-Armstrongs, Limited, have received an order for a passenger ship for the Union Steamship Company of New Zealand. The ship will be built at Barrow-in-Furness, and the main propelling turbo-electric unit will be supplied by the British Thomson-Houston Company, Limited, Rugby, in collaboration with Vickers-Armstrongs, Limited.

Messrs. Smith & Company (South Shields), Limited, of the Holborn Foundry, East Holborn, South Shields, recently constructed a solid cast-iron propeller, weighing 15½ tons. The diameter is 20 ft., the square 14 ft. 6 in., and the surface area in the four blades is 108 sq. ft. The casting of the propeller occupied five days, and, owing to its size, it will be transported by road to the Clyde, there to be fitted to a ship now in the course of construction.

Messrs. Alloy Welding Processes, Limited, of Ferry Lane, Walthamstow, London, E.17, inform us that practically the whole of their issued shares have been purchased by Messrs. Murex, Limited, of Rainham, Essex. Messrs. Murex, Limited, own all the share capital of the Premier Electric Welding Company, Limited, and also of Messrs. Thermit, Limited. The works of the Premier Electric Welding Company will shortly be removed to those of Alloy Welding Processes, Limited, who have ample accommodation in their new factory.

It is announced that under the scheme by which United Strip & Bar Mills, Limited, and the United Steel Companies, Limited, will be amalgamated and formed into a new company called the United Steel Companies, Limited, United Strip & Bar Mills, Limited, as a separate entity will cease to exist. The business of United Strip & Bar Mills, Limited, however, will be carried on, without any change, by the United Steel Companies, Limited, and the name of United Strip & Bar Mills will be retained. No change will be made in the direction and management of the United Strip & Bar Mills.

An effort to remove the handicap which the steel trade suffers through obsolete building regulations is being made by the British Steelwork Association, which is endeavouring to secure a national code of building regulations, drawn up and enforced by a central authority. In many cases existing regulations were framed when the data at the disposal of the authorities were meagre, and they are now unduly restrictive. It is thought that a revision of by-laws and the substitution of legislation based on the wide experience gained under a great variety of conditions in recent years would facilitate the construction of modern steel-frame buildings. Steel-frame buildings provide a valuable and increasing outlet for structural steel, and an expansion in this class of building is confidently anticipated as soon as the regulations which govern their construction are brought up to date.

Personal.

Mr. H. G. Herrington has joined the staff of Messrs. High Duty Alloys, Limited, of Slough, and will act as general manager.

Sir Auckland Geddes has resigned his seat on the board of the Amalgamated Metal Corporation, Limited. The Hon. R. M. P. Preston has been elected to fill the vacancy.

Mr. W. G. Weir, joint managing director of Messrs. David Rowan & Company, Limited, marine engineers and boilermakers, Glasgow, has retired. He has been connected with the firm for over 30 years.

Wills.

Gregson, W. H., of Messrs. Gregson & Monk, Vulcan Ironworks, Preston ...	£121,871
Esplen, Sir John, consulting engineer, of Messrs. Esplen, Son & Swainston, Limited	£38,551
Partridge, E., of Albrighton, Salop, managing director of the Steel Nut & Joseph Hampton, Limited	£13,208
Laing, Hugh, managing director of Messrs. Sir James Laing & Sons, Limited, shipbuilders, Sunderland ...	£30,523
Owen, A. E., of Messrs. Rubery Owen & Company, engineers, Darlaston, and a director of other companies ...	£902,171
Tait, A. W., lately chairman of the British Aluminium Company, Limited, and of Ferranti, Limited	£529,266
Readhead, Sir James, of South Shields, lately chairman and managing director of Messrs. John Readhead & Sons, Limited, shipbuilders	£711,133

Obituary.

Mr. Alexander Aitchison, who died at Dunbar recently, up to his retirement seven years ago was a well-known official at Messrs. Palmers Shipbuilding & Iron Company, Limited, being chief engineer at the iron and steel works department of the company for 33 years.

We regret to announce that Mr. Carl Brackelsberg, the inventor of the Brackelsberg furnace, was killed in an aeroplane accident last week. It was his custom to fly from one country to another where his furnaces were installed, and he had made many trips by air to Norway, Sweden, Holland, Switzerland and Russia. It is believed that, whilst flying to Sweden, his machine crashed and he was killed. His death will undoubtedly be a great loss to the iron and steel industry, for he was about to bring to fruition important and far-reaching developments. Mr. Brackelsberg was a man of the highest standing and integrity, and of a very fine character, which impressed itself on everyone who met him.

Company Meeting.

Allied Ironfounders, Limited.—The first annual meeting of Allied Ironfounders, Limited, was held recently. Mr. A. W. Steven (chairman) presided, and said that the shares in two additional companies had been acquired during the year. Allied Ironfounders, Limited, now owned 100 per cent. of the shares in nine companies, and over 99 per cent. of the shares in the remaining two companies, giving it control over 11 companies and 17 works. This represented a substantial proportion of the whole industry, both in the number of works and in productive capacity. Even so, the company could not prevent competition at uneconomic prices, which for some time had characterised certain branches of the trade. It could, however, exercise considerable influence. That influence had been, and would continue to be, used to bring about reasonable conditions in the industry, to mitigate or to prevent unreasonable competition in prices, to recognise the interests of its competitors, and to support all reasonable measures to safeguard the position of the merchants who acted as the distributors of its manufactures. By steadily pursuing this policy they hoped to promote the prosperity of the industry as a whole.

Reports and Dividends.

Aluminium Corporation, Limited.—Loss for 1929 of £62,854.

Steel Developments, Limited.—Interim dividend of 3 per cent.

Head, Wrightson & Company, Limited.—Profit, £17,558; brought in, £1,056; debenture interest, £6,750; preference dividends, £10,148; carried forward, £474.

Allen-Liversidge, Limited.—Net profit, £61,820; brought in, £14,043; provision for taxation, £6,000; reserve, £12,500; preference dividend, £16,250; final dividend of 5 per cent, making 9 per cent. for the year; carried forward, £14,113.

William Beardmore & Company, Limited.—Net profit, after providing for interest on 7 per cent. first mortgage debentures and other loans, but before providing for depreciation, of £18,142, which it is proposed to carry forward.

Union Steel Corporation (of South Africa), Limited.—Trading loss for 1929, £36,453; general expenditure, taxation, interest on and redemption of debentures, £45,482; total loss for year, £81,903; pig-iron bounty received, £7,479; brought in, £25,711; total debit carried forward, £71,468.

Bradley & Foster, Limited.—Net profit, after providing interest on debentures and loss on a subsidiary company, £4,787; provision for taxation, £776; depreciation reserve fund, £2,000; brought in, £1,339; five years' arrears of interest on the cumulative preferred ordinary shares up to March 30, 1929, £1,055; carried forward, £2,295.

New Companies.

L. B. S. Engineering Company, Limited, Hamilton Road, Lowestoft.—Capital £10,000. Permanent director: R. Plowright.

Andrews Metals, Limited.—Capital £1,000. Permanent managing director: H. Andrews, 14, Robin Hood Lane, Hall Green, Birmingham.

W. J. Woods, Limited.—Capital £1,500. Iron and brass founders, etc. Directors: W. J. Woods, White Hart Street, Thetford; and Mrs. E. Woods.

Russian Ore for United States.—The Mystic Iron Works, Everett, Mass., recently received 7,000 tons of Russian high-grade ore. It is the first lot of Russian ore purchased by the furnace, and the first received in the States since before the war.—"Iron Age."

World Power Conferences.—The third plenary meeting of the World Power Conference will take place in America in 1936. The International Executive Council has decided to accept the tentative invitation of Sweden and of the Scandinavian countries, and to suggest 1933 as the date of the next sectional meeting of the World Power Conference, to be held in Scandinavia, on the question of power supply of big industrial undertakings.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—A further restriction of furnace output in the Cleveland area last week is now confirmed, this making the sixth ironworks on the North-East Coast laid idle this year, with, it is feared, others to follow in the immediate future. There can be, however, no question of the justification of this movement on the part of the Cleveland ironmasters, who, forced by the stern logic of facts, have had no alternative to a drastic curtailment of production, as the sole remedial policy in the present position of this once prosperous industry. In the existing conditions it is difficult to realise, but is, nevertheless, an actual fact, that there has developed an undercurrent of optimism observable in market circles, based on the assumption that the worst has now been reached, and that a turn for the better may now be confidently expected as the season further advances to the period of autumn buying. For the present, purchases of pig-iron are mainly confined to small parcels to meet current needs. True, their requirements are not heavy, and there is still no disposition to enter into heavy forward commitments, as hopes of a fall in prices have not yet been finally abandoned. Meanwhile, official quotations remain undisturbed as follow:—No. 1 Cleveland foundry iron, 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; No. 4 forge iron, 66s. per ton.

Following the example of the foundry pig producers, makers of East Coast hematite have recently reduced outputs with the object of relieving heavy surplus stocks and thus enable the ironmasters to resist further reductions, and keep prices steady. East Coast mixed numbers are at 71s. and No. 1 quality at 71s. 6d. per ton. On the North-West Coast, Bessemer mixed numbers are still quoted at 72s. 6d. per ton at works.

LANCASHIRE.—Business in local markets for foundry pig during the current week has been exceptionally quiet, so far as actual new orders are concerned, users having filled their requirements over the next few weeks, and there still being no disposition, except where foundries are concerned with certain speciality products, to enter into contracts over a longer period. Last week's reduction in prices may, however, bring a change in buyers' policy, quotations now ruling:—No. 3 Derby and No. 3 Staffordshire, 74s. 6d., and Scottish makes 93s. to 94s., all per ton delivered local stations.

THE MIDLANDS.—The decision of the pig-iron producers to reduce prices has, so far, had little effect upon the local market, the foundry industry in the Black Country being unusually slack, and buying restricted to the lowest possible limits. Quotations, as revised, now stand as follow:—No. 3 Northants, 72s. 6d.; No. 3 Derbyshire and North Staffordshire, 76s.; all per ton delivered local stations.

SCOTLAND.—As all the works in Glasgow and district are closed down this week for the annual Fair holidays, there is really no business passing in pig-iron. It is reported that more blast furnaces are going out of action immediately, as it is not possible to find an outlet for even the reduced production. Prices remain unchanged on the basis of 76s. 6d. for No. 3 Scotch foundry.

Finished Iron.

There has been no improvement in the position of the manufacturing branches in the South Staffordshire district, with prices unchanged all round. There is, however, a fair demand for best quality marked bars at £12 10s. at works, but makers in this section are free from Continental competition. The quotation for crown bars is between £10 and £10 7s. 6d., and for nut and bolt iron £9 to £9 5s. Lancashire crown bars are quoted at £10 5s. per ton, and No. 2 material at about £8 15s. Merchant parcels of the former are quoted on the basis of 14s. 3d. per cwt., less 2½ per cent. and including delivery to buyers' works.

Steel.

Business in semi-finished steel during the week current has been quiet, but a fair tonnage of orders was recently placed with Continental works. The British producers of this class of material are again feeling the competition of the Continent, and the foreign manufacturers are now able, owing to the poor demand they have experienced for some time, to give early delivery. At Sheffield conditions are without improvement, the slightly increased demand for basic billets having been merely temporary, while acid billet requirements are on an extremely moderate scale. Output has been still further cut down. No price changes have taken place since last reported. The tinplate market remains dull, quotations still ruling at 18s. basis for coke quality, net cash, f.o.b. Welsh ports.

Scrap.

Consumers of all descriptions of foundry scrap metals are at the moment taking little interest in the various markets, and on Tees-side material is accumulating, and merchants are accepting cut prices to get rid of surplus stocks. The foundries are now able to purchase good ordinary heavy cast iron at 55s., and machinery quality in sizes of less than 1 cwt. is offered at 57s. 6d. per ton. In the Midlands conditions are very depressed, and prices are lower than they have been for many years, machinery cast-iron scrap being quoted at 65s. to 67s. 6d., and light cast-iron scrap 52s. 6d., delivered. In Scotland the markets this week are closed on account of the Glasgow Fair holidays, but are expected to resume business next week.

Metals.

Copper.—The close of the week's markets for base metals disclosed a renewed bear attack on prices of copper, the final quotation for standard marking £47 8s. 9d., another new low record. The decline of prices was also emphasised in forward sales. At the reduced level of values consumers bought sparingly, limiting their purchases to immediate requirements. The fact of the matter is that confidence in copper is entirely lacking.

Closing quotations :—

Cash.—Thursday, £47 12s. 6d. to £47 15s.; Friday, £47 8s. 9d. to £47 11s. 3d.; Monday, £47 8s. 9d. to £47 10s.; Tuesday, £48 2s. 6d. to £48 5s.; Wednesday, £48 2s. 6d. to £48 3s. 9d.

Three Months.—Thursday, £47 7s. 6d. to £47 10s.; Friday, £47 6s. 3d. to £47 7s. 6d.; Monday, £47 8s. 9d. to £47 10s.; Tuesday, £47 18s. 9d. to £48; Wednesday, £47 18s. 9d. to £48.

Tin.—Following the withdrawal of support of one of the leading producing interests, standard tin values again weakened to a further low record, the quotation ruling at one time last week having declined to £130 5s., while in 1927 the price had actually advanced to £313 per ton. There seems to be, however, a possibility of the July supplies being more compatible with present needs. The smelter production in the F.M.S. has been curtailed to a considerable extent during recent months, and the receipts of standard tin, which were very heavy for June, will probably be considerably smaller.

Official closing prices :—

Cash.—Thursday, £130 5s. to £130 7s. 6d.; Friday, £133 17s. 6d. to £134; Monday, £132 12s. 6d to £132 15s.; Tuesday, £131 7s. 6d. to £131 10s.; Wednesday, £134 7s. 6d. to £134 12s. 6d.

Three Months.—Thursday, £132 2s. 6d. to £132 5s.; Friday, £135 10s. to £135 15s.; Monday, £134 2s. 6d. to £134 5s.; Tuesday, £133 to £133 2s. 6d.; Wednesday, £136 to £136 2s. 6d.

Spelter.—Prices in this section of the market, after a temporary spurt, are depressed by heavy accumulations of metal, while the American stocks last month experienced another increase. There has been a recovery, however, from the week's lowest levels.

Daily fluctuations :—

Ordinary.—Thursday, £15 12s. 6d.; Friday, £15 15s.; Monday, £15 15s.; Tuesday, £15 18s. 9d.; Wednesday, £16 5s.

Lead.—The position of lead seems comparatively healthy. After a certain amount of fluctuation during the week, values became steadier, although conditions remain virtually unchanged.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £18 2s. 6d.; Friday, £18 3s. 9d.; Monday, £18 6s. 3d.; Tuesday, £18 5s.; Wednesday, £18 7s. 6d.

German Steelworks Union.

The report for 1929 of the Stahlwerks Verband, recently issued, deals with the final year's activity of this combine in its old form, the new organisation covering a larger ground and including almost all the subsidiary syndicates for rolled products.

The report states that the production of steel ingots and rolled products, as well as the deliveries of the Union, were several hundred thousand tons greater in 1929 than in the previous year, but the effects of the wage dispute in November and December, 1928, have to be taken into consideration. On the other hand, as compared with 1927 the production of rolled products in 1929 was less by about 650,000 tons and the deliveries by the Union were about 480,000 tons less.

Increased Exports.

During 1929 the deliveries per working day averaged 28,300 tons, as compared with 27,200 in 1928 and 29,000 tons in 1927. The lesser absorbing capacity of the inland market rendered it necessary to carry on increased activity in the world markets, so that the exports of syndicated products, which already in 1928 exceeded by 570,000 tons those in 1927, showed a further advance of 236,000 tons. On the whole, the foreign sales represented 32.55 per cent. of the total deliveries, as compared with 30.96 per cent. in 1928. However, the disposition abroad to purchase on a larger scale had given way to a state of increasing reserve. In order to prevent as much as possible a complete collapse in prices, the Continental Steel Cartel had decided upon a 10 per cent. restriction in production, but this measure alone had not proved to be sufficiently effective. As a consequence, steps had been taken to form common selling syndicates, which had had the effect of arresting to some extent the fall in prices and at the same time represented a noteworthy step forward in the direction of the attainment of the final aim of the establishment of Continental selling organisations. The accompanying table gives the details of the total turnover in the various products, shown separately for the inland and export trade, in tons of finished weight, in the past two years :—

Sales of the Steelworks' Union.
(1=1,000 tons.)

Products.	Total.		Inland. Percentage.		Exports. Percentage.	
	1929.	1928.	1929.	1928.	1929.	1928.
Semi-finished	999.2	992.7	43.31	42.63	56.69	57.37
Permanent way material	1,551.1	1,377.7	76.16	63.77	23.84	36.23
Shapes	1,048.1	1,076.5	69.11	72.98	30.89	27.02
Bars	3,235.7	3,232.4	69.98	74.81	30.02	25.19
Hoops	589.7	585.9	74.10	74.98	25.90	25.02
Plates	1,211.8	1,050.8	64.80	75.81	35.20	24.19
Total	8,635.6	8,316.0	67.45	69.04	32.55	30.96

Present Prospects.

As regards the present position, the report states that prospects are all the less hopeful, as the backward tendency in the German and the world markets has continued, and has resulted in a further decline in the sales of the syndicated products. A great depression prevails everywhere, owing to the hopes of expected relief in the burden borne by the industry not having materialised. Concerning the reduction in prices in June, the report states that this measure will only meet with success when the other branches of the industry take the necessary steps for a general reduction in prices. Moreover, it is suggested that industry must insist on the adoption of thoroughgoing measures of economy by public authorities instead of equilibrium in the budget being restored by additional taxes and burdens.

Cast-iron Gutter.—A flat-bottomed gutter of 12 in. by 8 in. section and 18 ft. in length took exactly 19½ secs. to run. The actual weight of the gutter was 15 cwts., the metal poured out of ladle 15½ cwts., and the number of runners two.

Clogged Files.—Files clogged with iron filings should be dipped in blue vitriol; those clogged with copper or brass should be dipped several times in nitric acid. When a file is clogged with aluminium or its alloys, a strong solution of potash should be used, as this will dissolve the aluminium. The files should afterwards be well rinsed in water to remove any trace of acid or alkali.

R. B. TENNENT, LTD.,

COATBRIDGE, N.B.

Telegrams: "Tennent, Founders, Coatbridge." Established 1857. Telephone: No. 425-426, Coatbridge.

IRON & STEEL FOUNDERS

SPECIAL AIR FURNACE IRON. SIEMENS' STEEL ONLY.

HEAVY CASTINGS

OF ALL KINDS FOR IRON AND STEEL WORKS

Iron Castings up to 100 tons each. Steel Castings up to 40 tons each.

CAST IRON FLANGED PIPES

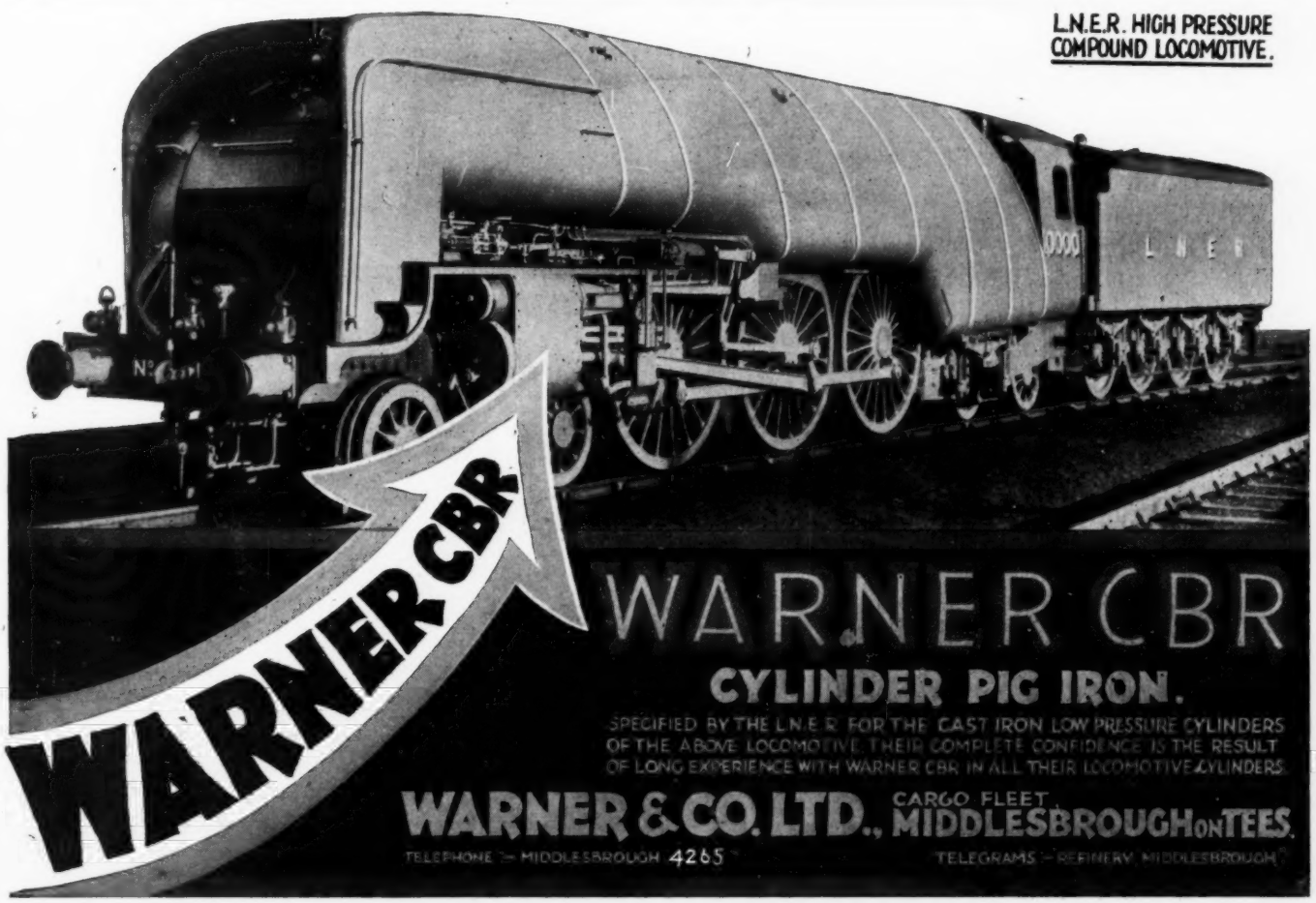
2 in.–12 in. & CONNECTIONS. to 24 in. dia.

WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

JAMES & RONALD RITCHIE, LTD.,

Telephone: 52 & 53. MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

L.N.E.R. HIGH PRESSURE COMPOUND LOCOMOTIVE.



WARNER CBR

CYLINDER PIG IRON.

SPECIFIED BY THE L.N.E.R. FOR THE CAST IRON LOW PRESSURE CYLINDERS OF THE ABOVE LOCOMOTIVE. THEIR COMPLETE CONFIDENCE IS THE RESULT OF LONG EXPERIENCE WITH WARNER CBR IN ALL THEIR LOCOMOTIVE CYLINDERS.

WARNER & CO. LTD., CARGO FLEET, MIDDLESBROUGH ON TEES.

TELEPHONE — MIDDLESBROUGH 4265 TELEGRAMS — REFINERY, MIDDLESBROUGH

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	48	2	6
Three months	47	18	9
Electrolytic	52	10	0
Tough	52	0	0
Best selected	52	10	0
Sheets	81	0	0
India	64	0	0
Wire bars	54	10	0
Do. August	54	10	0
Do. September	54	10	0
Ingot bars	54	10	0
H.C. wire rods	56	5	0
Off. av. cash, June	50	1	4½
Do., 3 mths., June	50	4	3½
Do., Sttlmnt., June	50	1	3
Do., Electro, June	57	11	9
Do., B.S., June	57	5	7½
Do., wire bars, June	58	8	6
Solid drawn tubes			12d.
Brazed tubes			12d.
Wire			8½d.

BRASS.

Solid drawn tubes	10½d.
Brazed tubes	12½d.
Rods, drawn	10½d.
Rods, extd. or rlld.	6½d.
Sheets to 10 w.g.	9½d.
Wire	9½d.
Rolled metal	8½d.
Yellow metal rods	6½d.
Do. 4 × 4 Squares	7d.
Do. 4 × 3 Sheets	7½d.

TIN.

	£	s.	d.
Standard cash	134	7	6
Three months	136	0	0
English	136	0	0
Bars	135	0	0
Straits	132	12	6
Australian	133	7	6
Eastern	135	0	0
Banca	135	7	6
Off. av. cash, June	136	7	8½
Do., 3 mths., June	138	5	8½
Do., Sttlmt., June	136	7	9

SPELTER.

	£	s.	d.
Ordinary	16	5	0
Remelted	15	0	0
Hard	12	10	0
Electro 99.9	18	5	0
English	16	7	6
India	14	10	0
Zinc dust	21	0	0
Zinc ashes	4	0	0
Off. aver., June	16	14	7½
Aver., spot, June	16	8	5½

LEAD.

	£	s.	d.
Soft foreign ppt.	18	7	6
English	19	15	0
Off. average, June	17	19	4½
Average spot, June	17	18	9½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	26	0	0
Do. V.M. ex-whf.	25	10	0
Rods	30	0	0
Boiler plates	22	0	0
Battery plates	23	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	38	0	0
Chinese	26	0	0
Crude	20	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	7 17 6
45/50%	11 10 0
75%	18 10 0
Ferro-vanadium—	
35/50%	12/9 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£16 0 0
Ferro-tungsten—	
80/85%	2/5½ lb.
Tungsten metal powder—	
98/99%	2/8½ lb.
Ferro-chrome—	
2/4% car.	£30 10 0
4/6% car.	£23 10 0
6/8% car.	£22 7 6
8/10% car.	£22 0 0
Ferro-chrome—	
Max. 2% car.	£33 10 0
Max. 1% car.	£36 17 6
Max. 0.70% car.	£37 17 6
70% carbon-free	11d. lb.
Nickel—99% cubes, or pellets	£175 0 0
Ferro-cobalt	9/7 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0
76/80% packed	£12 15 0
76/80% export	£10 15 0
Metallic manganese—	
94/96% carbonless	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 2
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	2	15	0	to	2	16	0
Bundled steel and shrngs.	2	11	0	to	2	13	0
Mixed iron and steel					2	10	0
Heavy cast iron	2	14	0	to	2	15	0
Good machinery for foundries					2	17	6
Cleveland—							
Heavy steel					2	10	0
Steel turnings					2	4	0
Cast-iron borings					2	0	0
Heavy forge					3	10	0
W.I. piling scrap					3	5	0
Cast-iron scrap	2	17	6	to	3	0	0
Midlands—							
Ord. cast-iron scrap					2	12	6
Heavy wrought					3	5	0
Steel turnings					1	7	0
Scotland—							
Heavy steel					2	11	6
Ordinary cast iron					2	18	6
Engineers' turnings					2	0	6
Cast-iron borings					2	0	0
Wrought-iron piling					3	11	6
Heavy machinery					3	3	6

London—Merchants' buying prices delivered yard.

Copper (clean)	43 0 0
Brass	32 0 0
Lead (less usual draft)	15 10 0
Tea lead	12 0 0
Zinc	9 0 0
New aluminium cuttings	58 0 0
Braziery copper	40 0 0
Gunmetal	42 0 0
Hollow pewter	100 0 0
Shaped black pewter	75 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	70/-
Foundry No. 3	67/6
Foundry No. 4	66/6
Forge No. 4	66/-
Hematite No. 1	71/6
Hematite M/Nos.	71/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	84/-
„ d/d Birm.	90/6
Midlands—	
Staffs. common*	—
„ No. 4 forge*	71/-
„ No. 3 fdry.*	76/-
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	67/6
„ fdry. No. 3*	72/6
Derbyshire forge*	71/-
„ fdry. No. 3*	76/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	79/-
„ No. 3	76/6
Hem. M/Nos.	79/6
Sheffield (d/d district)—	
Derby forge	66/-
„ fdry. No. 3	71/-
Lincs. forge	77/6
„ fdry. No. 3	72/6
E.C. hematite	85/6
W.C. hematite	88/-
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	69/6
„ fdry. No. 3	74/6
Staffs foundry No. 3	74/6
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	93/- to 94/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	93/- to 94/-
Monkland, No. 3	93/- to 94/-
Shotts, No. 3	93/- to 94/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)					10	15	0
Nut and bolt iron	9	0	0	to	9	5	0
Hoops					10	15	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip					10	15	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	15	0	to	10	10	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					7	17	6

and upwards

Flats—8 in. wide and over	8 12 6
„ under 8 in. and over 5 in.	8 17 6
Rails, heavy	8 10 0
Fishplates	12 0 0
Hoops (Staffs)	9 5 0 to 9 15 0
Black sheets, 24 g.	9 12 6 to 9 15 0
Galv.cor.shts., 24g.	11 17 6
Galv. fencing wire, 8g. plain	12 0 0
Billets, soft	5 17 6 to 6 5 0
Billets, hard	7 10 0 to 8 0 0
Sheet bars	5 12 6 to 6 0 0
Tin bars	6 0 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/1
Sheet to 10 w.g.	1/1½
Wire	1/2½
Rods	1/2
Tubes	1/6
Castings	1/1½

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
3/0 to 10 G.	1/5½ to 2/0½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.76
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.00
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	33.00
Sheet bars	33.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.80
Skelp, sheared steel	1.80
Steel hoops	2.20
Sheets, black, No. 24	2.55
Sheets, galv., No. 24	3.20
Sheets, blue an'l'd, No. 13	2.15
Wire nails	2.15
Plain wire	2.30
Barbed wire, galv.	2.80
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	27/6
„ furnace	18/- to 22/-
Durham and Northumberland—	
„ foundry	14/6 to 15/6
„ furnace	14/- to 14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box		18/-
„	28×20 „		36/-
„	20×10 „		26/-
„	18¾×14 „		18/9
C.W.	20×14 „		16/6
„	28×20 „		33/6
„	20×10 „		23/6
„	18¾×14 „		17/-
Terneplates	28×20		32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars and rods dead soft, steel	£11 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58¼%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
July	10 ..	47	12	6	dec.	2/6
,,	11 ..	47	8	9	,,	3/9
,,	14 ..	47	8	9	No change	
,,	15 ..	48	2	6	inc.	13/9
,,	16 ..	48	2	6	No change	

Electrolytic Copper.

		£	s.	d.		
July	10 ..	53	10	0	No change	
,,	11 ..	52	10	0	dec.	20/-
,,	14 ..	52	10	0	No change	
,,	15 ..	52	10	0	,,	,,
,,	16 ..	52	10	0	,,	,,

Standard Tin (cash).

		£	s.	d.		
July	10 ..	130	5	0	dec.	62/6
,,	11 ..	133	17	6	inc.	72/6
,,	14 ..	132	12	6	dec.	25/-
,,	15 ..	131	7	6	,,	25/-
,,	16 ..	134	7	6	inc.	60/-

Tin (English ingots).

		£	s.	d.		
July	10 ..	131	0	0	dec.	65/-
,,	11 ..	134	15	0	inc.	75/-
,,	14 ..	133	10	0	dec.	25/-
,,	15 ..	133	0	0	,,	10/-
,,	16 ..	136	0	0	inc.	60/-

Zinc Sheets (English).

		£	s.	d.		
July	10 ..	26	0	0	No	change
,,	11 ..	26	0	0	,,	,,
,,	14 ..	26	0	0	,,	,,
,,	15 ..	26	0	0	,,	,,
,,	16 ..	26	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
July	10 ..	15	12	6	dec.	2/6
,,	11 ..	15	15	0	inc.	2/6
,,	14 ..	15	15	0	No	change
,,	15 ..	15	18	9	inc.	3/9
,,	16 ..	16	5	0	,,	6/3

Lead (English).

		£	s.	d.		
July	10 ..	19	10	0	No	change
,,	11 ..	19	10	0	,,	,,
,,	14 ..	19	10	0	,,	,,
,,	15 ..	19	10	0	,,	,,
,,	16 ..	19	15	0	inc.	5/-

AVERAGE MONTHLY PRICES OF IRON HOOPS.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 5 0	6 10 0	6 3 0
1897	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 8
1898	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	7 0 0	6 11 6
1899	7 0 0	7 0 0	7 0 0	7 0 0	7 12 6	10 12 6	8 12 6	8 12 6	8 12 6	9 2 6	9 7 6	9 17 6	8 2 9
1900	9 17 6	10 7 6	10 7 6	10 7 0	10 12 6	7 12 6	10 12 6	10 12 6	10 12 6	9 17 6	9 2 6	9 2 6	10 3 8
1901	9 2 6	8 2 6	8 2 6	7 12 6	7 12 6	7 12 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 11 2
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 0
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 6	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 7 6	7 0 0	7 7 6	7 2 0½
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 1½
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 6 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5
1911	7 5 0	7 5 0	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 2½
1912	7 12 6	7 12 6	7 12 6	7 15 0	7 15 0	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1
1916	17 2 6	17 2 6	17 2 6	17 6 3	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 9 0	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1920	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	36 17 6	35 14 9
1921	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1922	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	13 4 6½
1923	14 0 0	15 0 0	15 0 0	15 0 0	15 6 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 16 0	14 15 0	14 18 3½
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½
1925	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1926	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	12 10 0	12 10 0	14 3 4
1928	12 10 0	12 7 6	12 0 0	11 13 6	11 15 0	11 12 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 14 10½
1929	11 10 0	11 10 0	11 10 0	11 10 0	11 9 0	11 5 0	11 5 0	11 5 0	11 5 0	11 2 0	11 0 0	11 0 0	11 5 11
1930	11 0 0	11 0 0	11 0 0	10 16 3	10 15 0	10 15 0	—	—	—	—	—	—	—

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